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Oldman River Dam

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VEGETATION INVENTORY
OLDMAN RIVER DAM

HARDY ASSOCIATES (1978) LTD.

VEGETATION INVENTORY
OLDMAN RIVER DAM

Prepared for:

ALBERTA ENVIRONMENT
PLANNING DIVISION

Prepared by:

HARDY ASSOCIATES (1978) LTD.

CALGARY ALBERTA

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SUMMARY

A dam and a reservoir on the Oldman River near Pincher Creek is to be constructed to provide water for multipurpose use including irrigation. The purpose of this report is to inventory the vegetation resources of the reservoir and areas downstream of the dam; to identify sources and develop a strategy for the harvest and salvage of plant material for reclamation; and to assess the effects of alteration of flooding regime on downstream cottonwood communities and floodplain wetlands. The methods used included a brief review of air photos, field survey, telephone interviews and data analysis. A vegetation map at a scale of 1:25 000 of the reservoir and surrounding area was prepared.

The vegetation of the Oldman River reservoir and area downstream to the western boundary of the Peigan Indian Reserve consists of 8 major communities ranging from grassland, through deciduous shrubs to deciduous and coniferous forests. In the reservoir, western wheat grass - June grass community is the most abundant vegetation type covering 57.3% of the area. The cottonwood community along the river floodplain is the second most abundant vegetation type covering 14.7% of the area. A mosaic of rough fescue - Parry oat grass, Saskatoon - choke cherry, skunk bush - creeping juniper, aspen, and Douglas fir vegetation communities cover 11.1%; while the remaining 16.6% is made up primarily of cultivated lands and two gravel pits. The limber pine community is not found in the reservoir area.

The distribution of vegetation is controlled primarily by chinook winds, grazing intensity and river regime. The high velocity, warm, dry, westerly winds have a very marked desiccating effect which restricts the growth of woody vegetation such that it is found mainly on sheltered north and east facing slopes of the uplands and valley slopes.

The grasslands as well as the shrub and forest vegetation communities may be considerably affected by grazing, browsing and trampling, which when combined with wind and summer rainfall are the most significant causes of soil erosion in the area. Cottonwood stands along the valley bottoms of the Castle, Crowsnest and particularly the Oldman river are dependent on periodic flooding, erosion and sedimentation events for stand establishment and growth.

No plants considered rare in Alberta were found in the study area, however the effects of drought, grasshoppers and overgrazing may have severely reduced the visibility of these species, if present. Although located primarily in the fescue grassland, the Oldman River study area contains components of other major vegetation zones as a result of the unique environment provided by the chinook winds and confluence of the three river valleys. Characteristic species of these other regions include balsam poplar from the north, prickly pear cactus from the east, narrow-leaved cottonwood from the south, and black cottonwood, Douglas fir and limber pine from the west. While none of these species are rare, all are at or near the limits of their range. This is a unique situation which may only be found elsewhere in Alberta along the Bow, North Saskatchewan and Athabasca river valleys where warm chinook winds blow through the mountain passes.

The productivity of the grassland vegetation types in terms of range condition and stocking rate for domestic livestock was found to be poor on the western wheat grass - June grass type, and fair on the rough fescue - Parry oat grass type. This range condition is likely an underestimation of the normal state due to the cumulative effects of drought, grasshoppers and overgrazing at the time of the field survey.

For wildlife, the diversity of tree and shrub vegetation types along the three river valleys and their adjacent slopes is particularly important in a predominantly agricultural area. The relative productivity of the native vegetation communities for wildlife is highest in the cottonwood stands along the river valleys.

Reclamation of surfaces disturbed by the dam development should have two major objectives, to control erosion and to reestablish vegetation compatible with adjacent native plant communities. Based on the general types and locations of disturbances two plant communities which grow on similar sites were selected as target types for the reclamation program. They are the western wheat grass - June grass type for dry, windy, exposed surfaces and rough fescue - Parry oat grass type for moist, generally north facing slopes.

Stands of these two communities were located near the dam abutments for the western wheat grass type, and along the east side of the Castle River within the reservoir for the rought fescue type. A strategy for protecting, harvesting and subsequent application of seed from these communities was developed. The sites should initially be fenced to prevent further livestock grazing. Harvesting of grass seed by conventional farm combines is recommended, except on steep slopes where hand methods are necessary. Seed should be stored under dry conditions (14% moisture content or less) and seed germination tests should be conducted prior to application.

Following site preparation and placement of salvaged topsoil, the disturbed areas should be seeded with the appropriate grass mixture at a general rate of 20 to 25 kg/ha, and up to 40 kg/ha on steep slopes.

Seed application on gentle slopes should be by range seed drill and on steep slopes by hand broadcast. A cover crop of Spring rye may aid in preventing soil erosion and help the establishment of the seeded species. Measures for fertilization, supplementary erosion control and supplementary watering are also recommended.

To increase species diversity on reclaimed areas, collections of local herbaceous species are recommended. The herbs should be those typically found in the target communities and priority should be placed on species which will provide erosion control and will fix nitrogen in the soil. The herb seed should be applied to the disturbed sites along with the grass seed.

Shrubs can provide additional species diversity and erosion control to the disturbed areas. Locally collected seed should be treated to break dormancy and reared in small soil containers. Planting should take place at the same time the grass seed with priority being given to areas of steep slopes to aid in erosion control.

The effects of altering the flooding regime on vegetation communities downstream of the dam are difficult to predict until a detailed model of the new river regime, including flood height, flood frequency, sedimentation and channel morphology is completed. Preliminary analysis indicates that there will be some reduction in flood peaks, sedimentation and possible channel erosion. The result is likely to be some reduction in cottonwood establishment along the gravel bars adjacent to the rivers. In addition the small reduction in flood peaks may allow the low shrub and cottonwood seedling areas to grow up to tall shrub and mature cottonwoods. The possible reduction in areas

of cottonwood seedling establishment may be mitigated by periodic planting of cottonwood seedlings every 10 to 20 years. These cottonwood seedling areas should be fenced to prevent losses due to livestock trampling and browsing.

Three permanent transets were established downstream of the dam where data on factors which may be influenced by the facility, including channel migration, sedimentation rate, cottonwood seedling establishment and vegetation growth can be monitored at periodic intervals following construction. The data from these transects, in conjunction with more detailed information on the effect of the dam on river flow regime, can then be used to quantitatively assess the downstream impacts on vegetation and also be used to develop or improve the mitigation measures.

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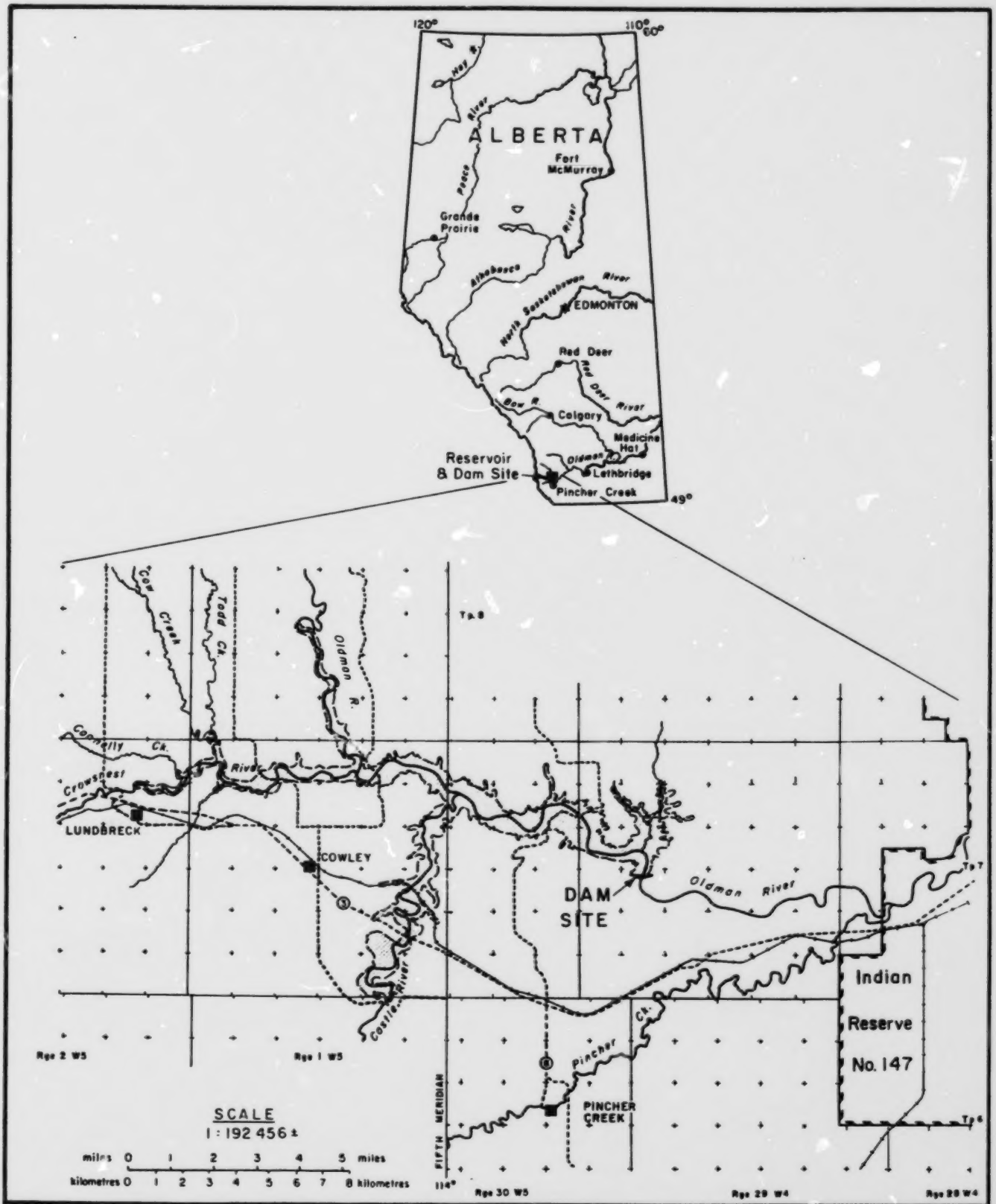
1.0 INTRODUCTION

The Government of Alberta announced in mid summer 1984 that a dam will be constructed on the Oldman River at the Three Rivers Site, to provide a dependable water supply for multipurpose use and to permit substantial expansion of irrigation in southwestern Alberta. The Planning Division of Alberta Environment is preparing an Environmental Mitigation/ Opportunities Plan for the project. The mitigation plan will be completed in phases: overview of existing information, data collection, and identification of possible mitigation strategies.

The following report is the second phase data collection and preliminary identification of possible mitigation strategies for vegetation. The vegetation overview covers the potential reservoir area near the confluence of the Oldman, Crowsnest and Castle rivers just north of Pincher Creek, and the downstream riparian habitats within the Oldman River valley east of the dam site to the western boundary of the Peigan Indian Reserve (Figure 1). The study was not extended into the Reserve as originally intended due to the refusal of the Band to allow access to the area.

1.1 STUDY OBJECTIVE

The purpose of the study is to assess the vegetation resources of the reservoir area and areas downstream that may be affected by the construction and operation of the dam. The emphasis of the study is to identify significant considerations for mitigation rather than a detailed accounting of resources lost. The specific objectives of the study are:



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OLDMAN RIVER DAM SITE AND RESERVOIR

FIG. 1

1) To groundtruth the preliminary vegetation map produced for the overview study and correct and refine as necessary;

2) To conduct an inventory of the major communities in the study area and note the presence of any rare or endangered species or communities;

3) To verify and refine the observations in the overview study regarding the relationships between topography, soils and vegetation;

4) To assess the productivity of each of the major communities with particular emphasis on the value of each for domestic livestock and wildlife;

5) To identify stands that may provide significant sources of seed or other propagation material for reclamation of disturbances associated with reservoir development;

6) To develop a strategy for harvest and salvage of plant material for reclamation including timing, methods, handling storage and viability trials if required; and

7) To assess the effects of the alteration of flooding regime on vegetation communities downstream of the dam to the LNID headworks, particularly cottonwood communities and floodplain wetlands.

1.2 PLAN OF THE REPORT

The report on the vegetation field study of the Oldman River Dam is divided into six major parts. The first part is a description of the major vegetation types based on the field reconnaissance, which is followed by a section on dominant ecological factors controlling vegetation. The third part is a brief review of the status of unique or rare plants, while the fourth is a discussion on reclamation strategies for the project area. The fifth section assesses the impacts of the dam on the downstream vegetation and describes the establishment of permanently marked transects for future monitoring studies. The final section contains recommendations for reclamation and monitoring.

1.3 METHODS

1.3.1 Background

Early in 1985, a report on the vegetation of the Oldman River area was prepared on the basis of literature review and air photo interpretation (Reid and Thompson 1985). The original mapping was done on 1972 and 1974 black and white air photos at scales of 1:21 120 and 1:24 000 respectively. Land use patterns, particularly the extent of cultivation in the grasslands, was checked on black and white photos taken in 1981 and 1982 at a scale of 1:60 000.

The following methods section deals primarily with the approach used to ground truth and inventory the preliminary vegetation map, to verify the ecological relationships between soils and vegetation, to assess the productivity of each vegetation type and to develop reclamation strategies. The methods used to assess impacts on the vegetation downstream of the dam are described later in Section 7.0.

1.3.2 Field Studies

The field survey was conducted during the period from July 2 to 12, 1985. The six major vegetation communities shown on the preliminary map were checked in the field by examining one to five representative stands of each homogeneous community depending on their extent in the study area. The boundaries of the communities were corrected and refined as necessary and the sample sites were marked on the map. The field survey resulted in the addition of two more communities to the map, western wheat grass - June grass and skunk bush - creeping juniper. New photography of the reservoir area using false colour infrared film was taken in June 1985, however the photos were not available for review prior to completion of this report. A new base mosaic of the reservoir area at a scale of 1:25 000 was provided.

An inventory of the species composition and relative abundance for each community was conducted in each of the above stands using a plotless sampling technique. The plant species cover and composition were noted in a circular area about 20 m in diameter on uniform site conditions i.e., a single or consistent topographic position, aspect and soil type. Visual percent cover of all dominant and subordinate species were recorded for each strata or layer present (tree, shrub, grass and herb, and moss. In forest types measurements of the height, diameter and age of one or two dominant trees were obtained. Each of the sample sites was also photographed (35 mm). The taxonomic nomenclature for vascular plants followed Moss (1983).

The successional status of each community was determined on the basis of tree regeneration particularly in forest types. In addition the influence of chinook winds, fire, beaver grazing and trampling by domestic livestock, and browsing by wildlife was noted.

The site conditions which influence the growth and development of each community was noted in terms of topographic position, slope, aspect and drainage class. A shallow representative soil pit was dug in each community to determine soil type, texture and rooting depth, but no detailed profile descriptions were made.

The productivity of the vegetation communities for domestic livestock in terms of range conditions and stocking rates was based on the guidelines prepared by Wroe et. al. (1981). The field methods in the guide were followed for assessing range condition and carrying capacity using percentage composition based on cover of known increaser, decreaser and invader species present in the grassland vegetation types. The percentage composition could not be reliably checked by clipping and weighing the herbage of each species, due to the reduced condition of the range as a result of drought and grasshopper damage.

The productivity and importance of the vegetation communities for wildlife was determined by having the study team wildlife biologist review the vegetation map and species composition, supplemented by consultation with the Wildlife Inventory consultant (D. Young, pers. comm.). The previous wildlife overview and the winter population study report was also briefly reviewed (Westworth and Brusnyk 1985).

Following the field reconnaissance the map units were confirmed and revised as necessary. The polygons were transferred to the new mosaic and the total area of each of the vegetation communities within the reservoir, as defined by the top of dam elevation (1121.7 m), was measured using a computerized digitizer. In addition, the area of each of the vegetation types above the dam but within the study area boundary was also measured.

1.3.3 Reclamation

The reclamation strategy was developed on the basis of the existing vegetation conditions and assumptions regarding the nature and extent of the project components including the dam, borrow pits and construction area. Telephone interviews were conducted with staff of the Coaldale Nursery Ltd. and Alberta Environment Research Station Vegreville regarding propagation of native shrubs and herbs. The focus of the reclamation work was on the dam site and adjacent areas, as reclamation of the drawdown zone in the reservoir is difficult and highly dependent on the stability of the new shoreline.

2.0 MAJOR VEGETATION TYPES

The Oldman River Dam area occurs predominantly in the Fescue Grass Ecoregion (Strong and Leggat 1981). The ecoregion, which lies between the aspen parkland to the north and the drier mixed grass region to the south and east, is characterized in its natural state by fescue and oat grass grassland, much of which has disappeared due to cultivation. Most of the remaining grasslands are now dominated by western wheat grass and June grass. Many of the sheltered positions provided by the rolling topography and the three river valleys are occupied by woody vegetation (Moss 1944, Moss and Campbell 1947, Moss 1955). North and east facing slopes of valleys and coulees, slough depressions, ridges and knolls are covered by shrubs such as saskatoon and choke cherry, and trees including aspen, Douglas fir, and limber pine. The flats of streams and rivers are commonly occupied by cottonwoods including several hybrids (Brayshaw 1965).

The soils of the Fescue Grass Ecoregion are typically Orthic Black Chernozems which have developed on a variety of lacustrine, morainal and glaciofluvial deposits (Alberta Institute of Pedology 1977). Ridges and knolls, valley slopes and floodplains have minimal soil development which are classified as Regosols.

The most important factor controlling vegetation at this site is the climate which is characterized by strong winds and high rates of evapotranspiration. The prevailing winds are westerly, of high velocity, warm and dry. The area receives long hours of sunshine throughout the year, and the average precipitation is 315 mm in the May to September period which accounts for just over 58% of the total (Environment Canada 1982).

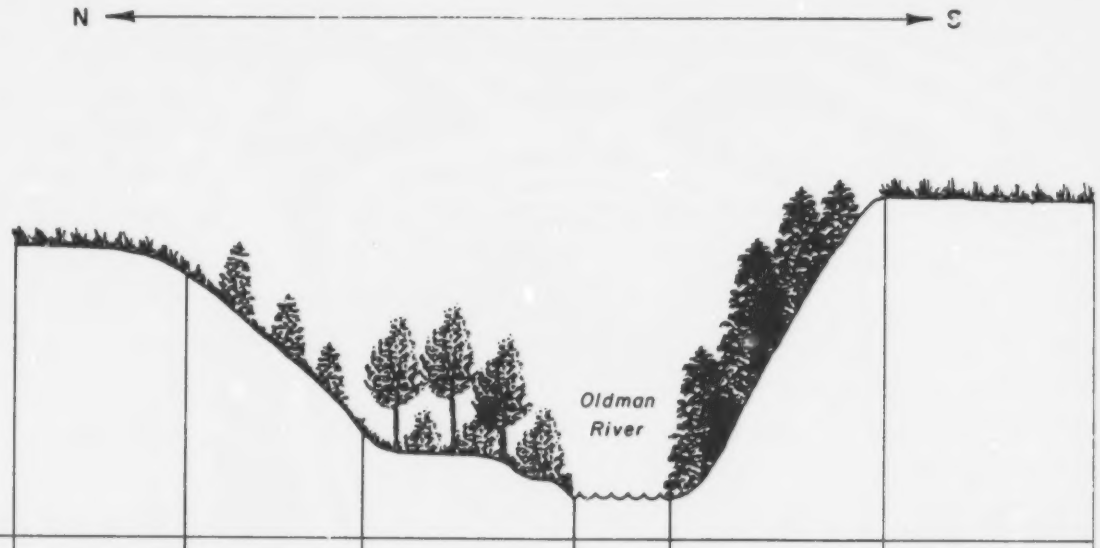
The six major vegetation community types range from grasslands, through deciduous shrubs to coniferous and deciduous forests. The location and extent of each of the major types is shown on Map 1 (map pocket). Data on the trees and understory species composition and cover for each of the 43 sampling sites is presented in Appendix A. A list of common and botanical names is presented in Appendix B, following nomenclature from Moss (1983).

The following descriptions emphasize the floristics and structure and include notes on site conditions and successional status. The percent ground cover of each layer is given and since each layer is considered separately, the total may exceed 100%. The vegetation can be broadly considered to reflect two distinctive site conditions based on landform and direction the slopes face (aspect). The typical vegetation of the broad and deep Oldman River valley oriented east-west is shown on Figure 2, while the vegetation typical of the narrow, steep sided Upper Oldman River valley, east of Cowley, oriented north-south is shown on Figure 3. This latter pattern of vegetation is also common on the upper portion of the Oldman River and Crowsnest River valleys.

2.1 WESTERN WHEAT GRASS - JUNE GRASS (MAP UNIT 1A)

This type is the most common grassland in the area and is characterized by an open community of western wheat grass and June grass as well as a few scattered low shrubs (Photo 1). The primary species are:

Shrubs (5%)	Herbs (15%)	Grasses (25%)
buckbrush	pasture sagewort	western wheat grass
ground juniper	broomweed	June grass
	pussy-toes	needle and thread grass



Vegetation Type	Western wheat grass - June grass	Skunk bush - creeping juniper	Cottonwood		Douglas fir	Western wheat grass - June grass and rough fescue - Parry oat grass
Landform	Lacustrine plain with eroded slopes		Fluvial flood plain		Shallow lacustrine material over bedrock	Lacustrine plain
Drainage	Well to rapid	Rapid	Imperfect to moderately well		Moderately well	Well
Dominant Soils	Orthic black chernozem	Orthic regosol	Orthic and Cumulic regosol		Regosol	Orthic black chernozem

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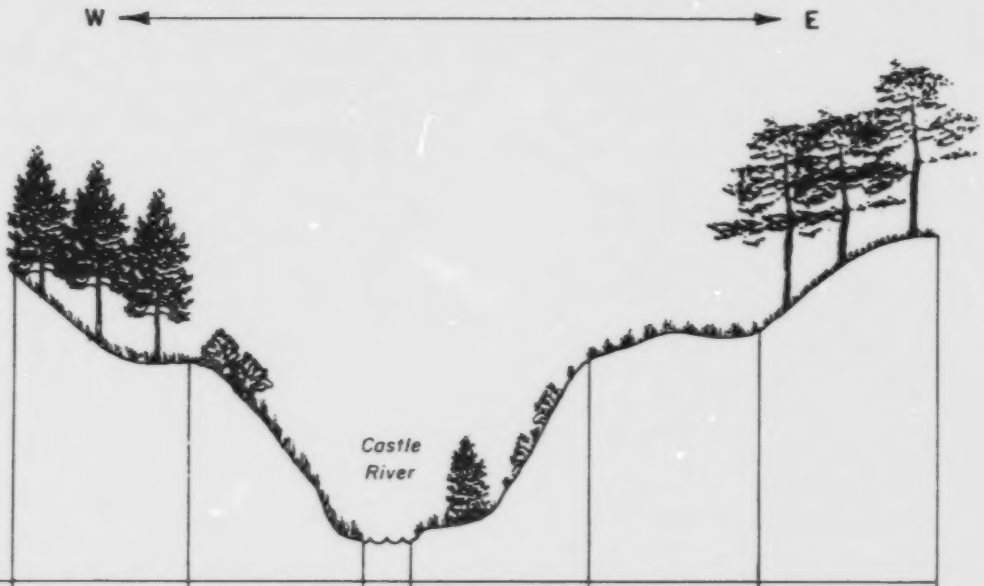
TYPICAL VEGETATION OF THE BROAD OLDMAN RIVER VALLEY NEAR BROCKET

Figure 2



Vegetation type	Aspen	Saskatoon – choke cherry and western wheat grass – June grass		Cottonwood and skunk bush-creeping juniper	Western wheat grass-June grass	Limber pine
Landform	Rolling moraine plain and shallow moraine over bedrock			Shallow lacustrine material over bedrock	Lacustrine plain	Shallow moraine over bedrock
Drainage	Moderately well	Well to rapid		Well to rapid	Moderately well	Well
Dominant soils	Orthic black chernozem	Orthic regosol		Regosol	Orthic black chernozem	Orthic regosol

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TYPICAL VEGETATION OF
THE UPPER OLDMAN RIVER VALLEY
EAST OF COWLEY

Figure 3

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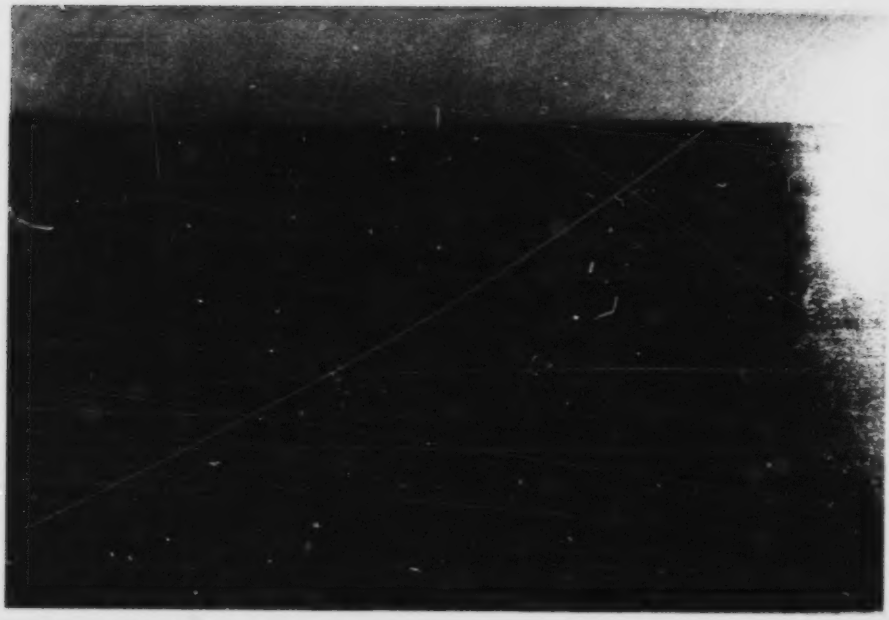


Photo 1. Western wheat grass - June grass vegetation type on banks of the Oldman River near the dam site.

Photo 2. Saskatoon - choke cherry type on north facing slope along Oldman River valley.

This type is found on a large variety of landforms including lacustrine, moraine and glaciofluvial plains as well as on high terraces adjacent to the river valleys. Soils are typically Orthic Black Chernozems on level to gently rolling areas with Orthic Regosols on slopes. The coarse to fine loam to clay textured materials are rapidly to well drained. The vegetation type represents a grazing disclimax (disturbance climax due to grazing) of the regional grassland climax, rough fescue - Parry oat grass type. The wheat grass - June grass type is well suited to open south and west facing slopes subject to drying winds. Occassional fires burn the area arresting the invasion of shrubs and trees. Grazing by livestock is the predominant use of the grassland. The type covers approximately 1435 ha or 57% of the reservoir area (Table 1), and 4260 ha or 46% of the lands from the top of the dam to the boundary of the study area.

2.2 ROUGH FESCUE - PARRY OAT GRASS (MAP UNIT 1B)

This type represents a grassland dominated by rough fescue and Parry oat grass which form distinctive bunches or tussocks, between which herbs and a few scattered shrubs are found. The primary species are:

Shrubs (10%)	Herbs (20%)	Grasses (30%)
shrubby cinquefoil	blazing star	rough fescue
prairie rose	prairie crocus	Parry oat grass
buckbrush	prairie sagewort	bluebunch fescue
	sticky purple geranium	

The fescue-oat grass type remains on a few landforms in the area namely lacustrine, and glaciofluvial plains as well as on higher terraces in the river valleys. The black soils (Orthic Black Chernozems) are moderately well drained, coarse to fine loam to clay textured materials.

TABLE 1

AREAS OF THE VEGETATION COMMUNITY TYPES IN THE OLDMAN RIVER RESERVOIR*

Vegetation Community Type		Area (ha)	Approximate % of Total Reservoir Area
1A	Western wheat grass - June grass	1435.3	57.3
1B	Rough fescue - Parry oat grass	45.7	1.8
2A	Saskatoon - choke cherry	75.9	3.0
2B	Skunk bush - creeping juniper	96.3	3.8
3	Cottonwoods	367.5	14.7
4	Aspen	10.2	0.4
5	Limber pine	0	-
6	Douglas fir	61.2	2.4
C	Cultivated	408.4	16.3
GP	Gravel Pit	6.2	0.3
TOTALS		2506.8	100.0

* Based on top of dam elevation (1121.70 m).

TABLE 2

AREAS OF THE VEGETATION COMMUNITY TYPES BETWEEN THE OLDMAN RIVER RESERVOIR AND THE STUDY AREA BOUNDARY

Vegetation Community Type		Area (ha)	Approximate % of Area
1A	Western wheat grass - June grass	4259.7	46.2
1B	Rough fescue - Parry oat grass	36.9	0.4
2A	Saskatoon - choke cherry	129.5	1.4
2B	Skunk bush - creeping juniper	47.4	0.5
3	Cottonwoods	0	0.0
4	Aspen	35.3	0.4
5	Limber pine	4.9	0.1
6	Douglas fir	62.0	0.7
C	Cultivated	4607.3	49.9
GP	Gravel Pit	10.2	0.1
	Town of Lundbreck	27.3	0.3
TOTALS		9220.4	100.0

The vegetation type represents the regional climax for most parts of the black soil zone and is found locally on north and east facing slopes on the east side of the Castle River and on a small area on the west side of the Oldman River north of the confluence with the Crowsnest River. Occasional grass fires burn the area and arrest the invasion of shrubs and trees. Grazing is the predominant use of this grassland. The rough fescue-oat grass type covers approximately 46 ha or 1.8% of the reservoir area (Table 1).

2.3 SASKATOON - CHOKE CHERRY (MAP UNIT 2A)

This type consists of open to dense clumps of shrubs 1 to 3 m high that are usually located within the western wheat grass - June grass vegetation type (Photo 2). The primary species are:

Shrubs (80%)	Herbs and Grasses (30%)
saskatoon	cow parsnip
choke cherry	kidney - leaved violet
buckbrush	awnless brome

This shrub type is frequently found on north to northeast facing moderately to strongly rolling slopes of morainal, glaciofluvial deposits and fluvial terraces. The Regosols are moderately well to well drained with a coarse-fine loam and clay texture. These cooler aspect slopes accumulate snow, which melts late in the spring, providing moisture well into the summer. The shrub communities are not only limited by climate, but are periodically severely reduced by grass fires and trampling by livestock.

2.4 SKUNK BUSH - CREEPING JUNIPER (MAP UNIT 2B)

This type consists of open to scattered clumps of shrubs 0.5 to 1 m in height with occassional grasses (Photo 3). The primary species are:

Shrubs (35%)	Herbs and Grasses (25%)
skunk bush	prickly pear cactus
creeping juniper	pasture sagewort
	western wheat grass
	needle and thread grass

The skunk bush - creeping juniper type is found on steep south and west facing slopes above the river courses. The soils are rapidly drained, eroding Regosols on shallow lacustrine material over bedrock. The texture is variable from coarse with sandstone boulders to clay loam. These slopes often have a terraced appearance due to soil creep. Severe drought due to wind is also a major factor limiting the vegetation cover. Livestock grazing is limited on these slopes due to the steepness and low vegetation cover.

2.5 COTTONWOODS (MAP UNIT 3)

This vegetation type represents open to closed stands of hybrid cottonwoods ranging in height from 12 to 18 m with numerous shrubs and some herbs (Photo 4). The primary species are:

Trees (40%)	Shrubs (30%)	Herbs and Grasses (45%)
cottonwoods	buckbrush	awnless brome
	prickly rose	bluegrass
	saskatoon	golden bean
		common dandelion

Photo 3. Skunk bush - creeping juniper type on northwest side of the upper Oldman River. Note prickly pear cactus to the left of the soil auger.

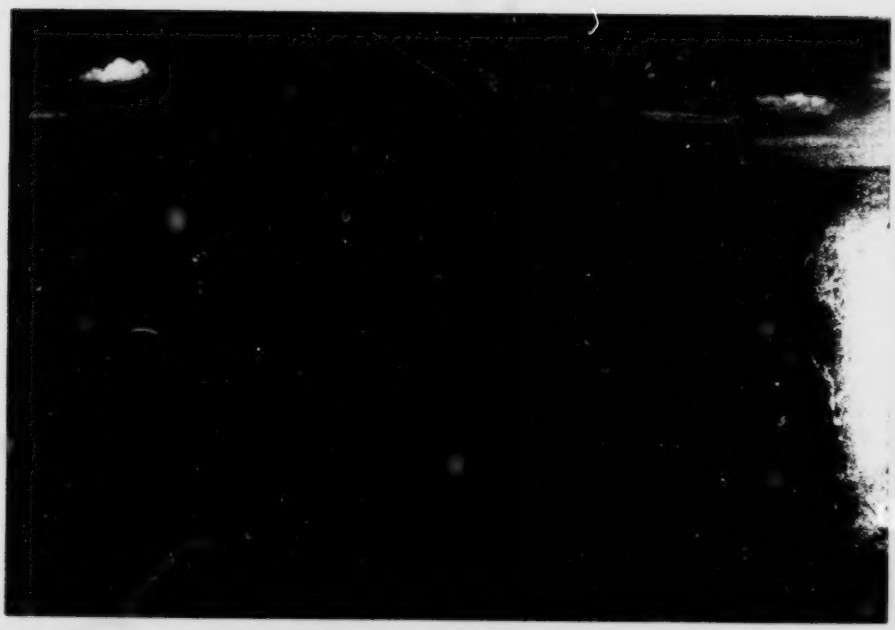


Photo 4. Cottonwood stand on west side of the Castle River.

The cottonwood stands occupy narrow bands along the Crowsnest and Castle rivers, and reach their largest extent along the broad floodplain of the Oldman River below the dam site. This type occupies fluvial floodplains and older point bar deposits where the sandy fine loam to gravel soils are moderately well drained except during snowmelt and periods of high precipitation. The sites are subject to annual flooding, sedimentation (Photo 5), erosion and ice scour, as well as occasional beaver logging. Farm buildings, houses and corrals for livestock are found throughout the cottonwood community and, as a result, the understory often is trampled and heavily grazed.

A variety of hybrid cottonwoods occur in the community type, however narrowleaf cottonwood is the most common species colonizing the newly exposed point bars. The species seems to be unable to compete with the other cottonwoods once the tree canopy is formed, as trees with characteristic balsam poplar and black cottonwood features dominate mature stands.

Between the mature cottonwood forest and the river water edge is a zone of cottonwood and willow seedlings, and a barren bar of sand or gravel, both of which are included in the map unit. The cottonwood regeneration area is covered up to 60% by shrub sized cottonwoods and sandbar willow as well as the grasses - red top, and bluegrass. The cottonwoods are maintained in the seedling stage by annual flooding, sedimentation, erosion, ice scour and beaver logging. Over time as sediment accumulates these seedlings will grow and mature to form a cottonwood stand.

The floodplains along the Crowsnest River are often dominated by water birch, 4 to 5 m high, and occasional cottonwood with an understory of red osier and bluegrass. The water birch type is included in the cottonwood map unit because of its small area.

Photo 5. Partially excavated cottonwood on Transect 107 showing multiple adventitious root system which has developed in response to succeeding sedimentation events.

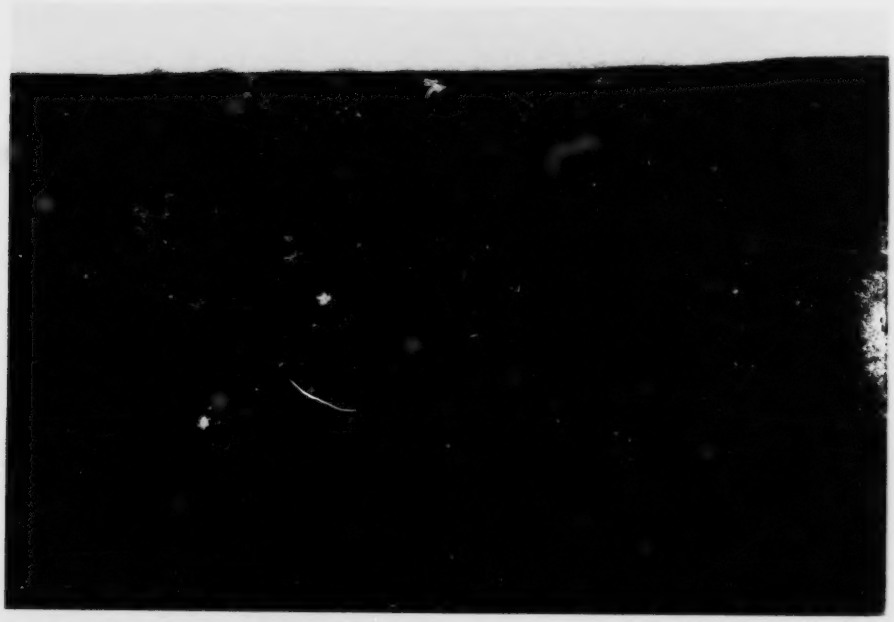


Photo 6. Aspen stand on west side of Castle River. Note skunk bush - creeping juniper type along slope.

2.6 ASPEN (MAP UNIT 4)

This type represents small "bluffs" of aspen 4 to 13 m high that are associated with western wheat grass - June grass and Saskatoon - choke cherry types (Photo 6). The primary species are:

Trees (65%)	Shrubs (35%)	Herbs and Grasses (70%)
aspen	buckbrush	awnless brome
	prickly rose	bluegrass
	saskatoon berry	common danelion
		kidney-leaved violet

This vegetation type occurs on north and east facing slopes made up of shallow lacustrine material and moraine over bedrock. The soils (Orthic Regosols) are moderately well drained on loam and clay textured materials. Aspen stands are quite rare in the study area, not only due to the dry climate, but also due to fire and grazing which prevents aspen from invading and eventually dominating the saskatoon - choke cherry type which grows in similar site conditions. Grazing by livestock has resulted in considerable trampling of the understory.

2.7 LIMBER PINE (MAP UNIT 5)

This type represents an open stand of pine 4 m high with a ground cover of low shrubs and grasses (Photo 7). The dominant tree species are limber pine and occasional Douglas fir, both of which commonly show a dwarfed and distorted habit with extensive killing of branches on the windward side of the crown. The primary species are:

Photo 7. Limber pine stand on hill east of the Oldman River.

Photo 8. Douglas fir stand on the east side of the Castle River. Note rough fescue - Parry oat grass type on adjacent plains.

Trees (35%)	Low Shrubs (40%)	Herbs and Grasses (25%)
limber pine	ground juniper	western wheat grass
Douglas fir	creeping juniper	needle and thread grass
		June grass

This vegetation type occurs on higher, drier south and west facing slopes and crests of ridges and rock outcroppings. The soils are well to rapidly drained on coarse textured materials which has developed from weathered sandstone and shale. The trees are able to survive on these exposed sites because an adequate amount of groundwater is available to the roots. The limber pine type with the western wheat grass - June grass type, form a parkland which is subject to grazing and trampling by livestock as well as occasional fires. Due to its location on the upper slopes and crests of hills, this type is not found in the reservoir area.

2.8 DOUGLAS FIR (MAP UNIT 6)

This type occurs as a closed, relatively tall (9 to 16 m high) stand of Douglas fir and rare limber pine with a sparse shrub and herb layer (Photo 8). The primary species are:

Trees (65%)	Shrubs (10%)	Herbs (30%)
Douglas fir	saskatoon	western wheat grass
	choke cherry	feathermoss
	buckbrush	

This vegetation type occurs on north to northwest or northeast facing, moderate to steep slopes of shallow lacustrine material and moraine over bedrock. The soils (Regosols) are well drained on gravelly sand

textured materials. In addition to disturbances caused by grazing and fire, some of the steep slopes on the outside of river bends are subject to river undercutting and slumping.

2.9 CULTIVATED (MAP UNIT C)

This type represents areas of land utilized for agriculture such as grain crops, hay crops, summer fallow and improved pasture, as well as farmsteads and buildings. Due to the changes in cultivation practices since the last set of air photos in 1981 and 1982 areas of grain crops and summer fallow could not be reliably distinguished from hay crops and improved pasture. This unit occurs on level to gently rolling lacustrine, glaciofluvial, morainal deposits and fluvial terraces, where the Orthic Black Chernozem soils are moderately well drained, coarse to fine loam and clay textured materials.

2.10 GRAVEL PIT (MAP UNIT GP)

Several gravel pits are located on the glaciofluvial deposits on the south side of the Oldman river west of Brocket. The pits are in various stages of development from active to abandoned.

3.0 DOMINANT FACTORS CONTROLLING VEGETATION

The dominant factors controlling vegetation on a regional basis are climate, topography and soils. Thus the Oldman River study area is a predominately grassland area due to the dry environment, however, variations in topography and soil moisture create conditions suitable for the growth of shrubs and trees as described previously. The distribution of vegetation is modified on a local basis in the project area often as the result of chinook winds, fire and grazing on the uplands as well as flooding, sedimentation and beaver logging along the river valleys.

3.1 CHINOOK WINDS

The high velocity, warm, dry chinook winds blowing out of the Crowsnest Pass make the project area one of the most windy in Alberta. During the winter, these winds produce rapid increases in temperature and quick melting of snow. Indirectly they may produce winter killing of plants by desiccation or by breaking of dormancy prior to the normal growing season. In the winter, by causing snowmelt, they reduce the amount of available moisture. In the spring, they may increase the availability of moisture by rendering the soil more receptive to rain and melting snow.

During summer, these winds have a very marked desiccating effect on soil and vegetation and as a result may initiate or increase wind erosion of soil from cultivated fields and steep slopes. The area around the junctions of the three rivers (Oldman, Castle and Crowsnest) is subject to persistent wind action from the west or west southwest, which has resulted in numerous areas of bare ground that are subject to sheet wash and rill erosion during rainstorms (Northwest Hydraulic Consultants Ltd. 1980). Features of this type are seen particularly along the east side

of the Castle River near the Canadian Pacific Railway, and along the north side of the Crowsnest River and its tributary valleys east of Lundbreck. This type of erosion coupled with that induced by vegetation removal due to cattle grazing discussed below is considered by Northwest Hydraulic Consultants Ltd. (1980) as being the most significant erosion process in the study area.

3.2 FIRE

Historically fire has been the major factor in limiting the growth of woody species in the prairie region. Moss (1944) reports that the aspen stands tended to be even-aged and rather young owing to the burning of areas prior to the time of his study. There are no reported recent occurrences of fires in the reservoir area, however grass fires on the uplands are common (L. Allison, pers. comm.). Downstream of the dam site, two brush fires in the cottonwood stands on the Indian Reserve north east of Brocket occurred in July 1985.

3.3 GRAZING

Domestic grazing is common throughout the area and tends to inhibit the growth of woody vegetation. The use of the cottonwood stands for grazing depends on access and local livestock management. On some flats, cattle use the area throughout the summer because of the proximity of the river, and are often wintered on the flats as well. In the latter case, grasses and herbs as well as shrubs are grazed and browsed, or trampled, and young trees are pushed over and root systems damaged. The removal of surface vegetation and trampling by cattle contributes to soil erosion on river banks and steep slopes. The effects of livestock grazing were compounded in the summer of 1985 by drought and high grasshopper populations which consumed much of the remaining plant material on the rangelands.

3.4 RIVER EROSION AND SEDIMENTATION

River channel shifting and the process of exchanging sediment between eroding banks, and depositing bars and banks a short distance downstream is not an important feature of the Oldman River in the study area (Northwest Hydraulic Consultants Ltd. 1980). In a study of the Milk River, in a similar environment but in a smaller river and valley, Bradley (1982) found that rates of river channel migration to be 1.8 m/yr, while on the Red Deer River which is of comparable size to the Oldman, Neill and Galay (1967) found the rate to be 3 m/yr. Rates of floodplain sedimentation along the Milk River changed from an initial 16 cm/yr for the first ten years following formation of the point bar, to 2 cm/yr over a 70 year period based on an analysis of cottonwood ages (Bradley 1982). Similarly, the sedimentation rate along the Oldman River, just downstream of the dam site at transect 107 is 2.5 cm/yr over an 83 year period. The sediment appears to be deposited during periodic high flood events and not as a continuous process as indicated by the uneven root system development of cottonwoods.

The last major flood along the Oldman River occurred in June 1975 with the result that many channel features such as point bars, gravel and sand bars and high water channels changed in size and shape. The most interesting vegetation feature is that none of the cottonwood seedlings on the point bars are more than ten years old, indicating that periodic major flood events are responsible for providing the necessary seedbed conditions which allow cottonwood stands to become established.

3.5 BEAVER LOGGING

Beaver logging currently occurs throughout the cottonwood stands along the river valleys (L. Allison, pers. comm.). This activity in conjunction with heavy grazing by livestock may result in the elimination of cottonwoods from some floodplain areas.

4.0 UNIQUE COMMUNITIES AND RARE PLANTS

While the Oldman River study area is regionally part of the fescue grassland, it contains components of other major vegetation zones (ecoregions) as a result of the unique environment provided by the confluence of the three river valleys. From the boreal forest in the north, balsam poplar and its hybrids are found along the river floodplains. Prickly pear cactus, a common species of the short grass prairie to the east, reaches its western range extension possibly as far as Lundbreck, on the dry exposed south and west facing slopes along river valleys. Narrow-leaved cottonwood has entered the area from the south, and its hybrids are common along the recently exposed point bars of the rivers. Finally, several tree species from the Montane forest to the west; black cottonwood and its hybrids, Douglas fir and limber pine; are able to survive in the protected and moist sites along the river floodplains and valley banks.

None of the above species are rare in Alberta, however several are at or near the limits of their range in the study area. The presence of species typical of four different ecoregions in one small area is uncommon, although somewhat similar conditions exist in Bow, North Saskatchewan and Athabasca river valleys. These river valleys are also connected to major mountain passes that allow warm chinook winds to enter the province from the west.

Hybrids, among five of the six species of cottonwood (Populus sp.) in Alberta, are very common along the major river valleys in southern Alberta; i.e., Red Deer, Bow, Oldman, South Saskatchewan and Milk rivers. Brayshaw (1965) believes that crossing among the cottonwood species of this region has been proceeding for many generations on natural alluvial habitat. The instability of this habitat favors hybrids, giving them opportunities for establishment on a variety of

soils free from competition by established parent populations. While a detailed analysis of the hybrid cottonwoods was beyond the scope of the study, the hybrid population was abundant both upstream and downstream of the dam.

Of the species listed for the study area by Moss (1944) or collected during this study, none are considered to be rare, as defined by Argus and White (1978) and Packer and Bradley (1984).

On the basis of the small distribution maps provided by Packer and Bradley (1984), the following are thirteen rare species that may occur in the study area:

Danthonia unispicata (one-spike oat grass)
Festuca occidentalis (western fescue)
Glyceria elata (tall manna grass)
Trisetum cernuum (nodding trisetum)
Juncus nevadensis (Nevada rush)
Pterospora andromedea (pine-drops)
Hydrophyllum capitatum (woolen-breeches)
Nemophila breviflora (small baby-blue-eyes)
Phacelia linearis (narrow-leaved scorpion weed)
Mertensia lanceolata (prairie or narrow-leaved lungwort)
Penstemon eriantherus (crested beard-tongue)
Aster campestris (meadow aster)
Stephanomeria runcinata (rush-pink)

None of the above species were found during the field survey, owing to the reduced cover and limited number of species visible as a result of drought and grasshopper and livestock grazing. A more thorough examination of the area in another year may identify some of the above species in the reservoir area.

5.0 PRODUCTIVITY OF MAJOR VEGETATION UNITS

5.1 DOMESTIC LIVESTOCK

The productivity of the major vegetation types was assessed in terms of range condition and carrying capacity (stocking rate) for domestic livestock (Wroe et al. 1981). The range condition is the present state of the vegetation compared with that of the climax or original vegetation for the range site. The range condition at the time of the field survey (July 1985) is likely an underestimation of the normal condition due to the cumulative effects of the drought, grasshoppers and livestock grazing.

The range condition for the grassland units is based on the current percent composition of species compared to the original or climax vegetation. The western wheat grass - June grass type is in poor condition while the rough fescue - Parry oat grass type is in fair condition (Table 3).

The shrub vegetation types provide some forage and shelter to livestock. The aspen, limber pine and particularly Douglas fir vegetation types are used extensively by livestock for shade and shelter. Ranchers and farmers rely heavily on the cottonwood stands along the river valleys for both summer and winter shelter for livestock.

5.2 WILDLIFE

The importance of each vegetation type for wildlife is listed below in point form, for each of the categories - ungulates, other mammals and birds. A more detailed assessment of the wildlife populations and habitat use is presented in the wildlife component of this project (Young et al. 1985).

TABLE 3

RANGE CONDITION OF THE GRASSLAND VEGETATION TYPES
(based on Wroe et al 1981)

Vegetation Type	Plot No.	Range Site	Original or Climax Proportion (%)	Range Condition Class	Stocking Rate AUM/ ha
Western wheat grass - June grass	1	Clayey	20	poor	
	4	Loamy	15	poor	
	8	Sandy	15	poor	
	12	Sandy	20	poor	
	22	Sandy	25	poor	
	24	Sandy	10	poor	
		MEAN	17.5	poor	0.24
Rough fecue - Parry oat grass	41	Loamy	35	fair	0.32

Western Wheat Grass - June Grass:

1. Ungulates (primarily mule deer in reservoir area, white-tailed deer are more abundant downstream of dam site)
   - Seasonal foraging habitat
   - Southwest-facing valley slopes with reduced snow accumulations may be traditional and important winter and spring foraging habitat

2. Other Mammals
   - Primary habitat of plains-dwelling species of furbearers (coyotes, red fox, badger, long-tailed weasel) and small mammals (white-tailed jack rabbit, Richardson's ground squirrel and several species of mice and voles).

3. Birds
   - Primary habitat of grassland - dwelling species including a variety of passerine birds, sharp-tailed grouse, burrowing owl, and Hungarian partridge.

Rough Fescue - Parry Oat Grass

- The value of this community for wildlife is generally similar to that described for western wheat grass - June grass habitats. Differences would likely involve the relative abundance of mammal and bird species rather than major differences in species diversity.

Saskatoon - Choke Cherry Vegetation Type

1. Ungulates
   - Important thermal cover, hiding cover and fawning cover in the appropriate seasons and escape terrain in all seasons.
   - Provides an abundance of palatable browse which often predominates deer diet during winter.
   - Provides herbaceous and woody plant forage during spring, summer and fall seasons.

2. Other Mammals
   - This shrub dominated vegetation type provides shelter and denning habitat for some plains - dwelling species (coyote, long-tailed weasel, skunk).
   - Provides suitable or primary habitat for small mammal species (Netalls's cottontail, deer mouse, shrews).

3. Birds
   - Primary nesting and foraging habitat and secure cover for a variety of passerine and other birds.

Skunk-bush - Creeping Juniper

1. Ungulates
   - The rugged steep slopes provide winter thermal cover, visual obscurity and escape terrain.
   - The steep south and southwest facing slopes often provide snow free areas important to deer foraging during winter.
   - Available forage may also be used during other seasons and particularly early spring.

2. Other Mammals

- This vegetation type likely provides secondary habitat used by various species dependent on grassland, shrub or forest cover in adjacent areas.
- The bedrock outcrops may provide suitable roosting sites for some of the bat species present along the Oldman River valley, but hibernating or roosting sites have not been identified.
- Collapsed bedrock, rubble areas support yellow-bellied marmot colonies.

3. Birds

- Canada geese have been shown to use rock outcrops and suitable ledges on steep eroding slopes as nest sites.
- Bedrock outcrops and ledges on eroding slopes also provide raptor nest sites (eyries) (e.g., prairie falcons, ferruginous hawks).
- Cliff swallows are reported to nest in large numbers beneath overhanging cliffs along rivers and creeks in the study area.

Cottonwood

1. Ungulates

- Wooded river flats, coulees and floodplains provide protective cover and are particularly important in grassland regions.
- Cottonwood stands with a dense shrub understory provide browse and thermal cover in winter, as well as fawning cover and other seasonal habitat requirements.
- Mid-river islands are important mule deer fawning sites.

2. Other Mammals

- Beaver depend on cottonwoods, willows, and other deciduous species for forage and construction materials.
- The cottonwood vegetation type is a primary habitat of woodland species (e.g., bobcat and raccoon) that typically inhabit deciduous woodlands.
- This vegetation type also includes the primary habitat of mink.

3. Birds

- Canada geese nest on wooded islands and along the cut banks of the Oldman River.
- Riparian cottonwood communities are exceptionally productive avian habitats, capable of supporting greater density and diversity of birds species than most other western terrestrial habitats. Additionally the associated river and back water habitats attract waterfowl, and other aquatic birds for breeding or during migrations. Current abundance of species is relatively low.
- Cottonwood trees provide nest sites for large buteo raptors (red-tailed hawk, Swanson's hawk, ferruginaus hawk and great horned owl).
- Dead snags are used by cavity nesters (woodpeckers). Abandoned nesting cavities are often used by Kestrels for nesting.

Aspen

1. Ungulates

- The east and north facing aspen slopes provide year-round cover for deer and are often preferred in summer and fall seasons. Aspen forest may also provide winter thermal cover.

2. Other Wildlife

- No exceptional value of this habitat is noted for other mammals or birds but it is expected to provide suitable habitat for a variety of woodland species.

Limber Pine

- The available information does not identify the limber pine vegetation type as having any exceptional value as wildlife habitat. The steep slopes along the southern exposures may provide winter habitat for mule deer.

Douglas Fir

- Douglas fir vegetation is the primary habitat for forest species such as red squirrel, marten and some species of birds. A variety of other birds and mammals will also inhabit or seasonally use this vegetation type.
- Mule deer use coniferous stands for winter thermal cover.

Cultivated Lands and Improved Pasture

- The value of improved pasture as wildlife habitat is likely similar to the values described for native grasslands. However, the suitability of the improved pasture habitat for prairie wildlife species is variable and depends on the type and diversity of grass species planted, time since planting (and hence the nature and amount of native species invasion) and the degree of grazing by domestic livestock.

- Cultivated lands are normally managed for production of cereal crops. While a variety of birds and mammals use this type of habitat, the abundance and diversity of species is normally much less than in permanent native grasslands.
- White-tailed deer reach their highest densities in agricultural areas as long as adequate woody cover is available. Cereal and legume crops can provide an important or supplementary source of forage for deer along valley and coulee habitats.
- Cultivated lands and improved pastures can provide important seasonal food sources for geese and, some dabbling ducks.
- Both mule deer and white-tailed deer forage in upland stubble fields and in cultivated valley bottom sites.

Gravel Pit

- Gravel pits are normally devoid of vegetation and hence of little value as wildlife habitat.

In a region which is predominantly cultivated, the diversity of natural vegetation along the three river valleys and adjacent slopes is very important to wildlife. The relative productivity of the native plant communities for wildlife, particularly the cottonwood stands along the floodplains, is much higher than that on the adjacent agricultural lands.

6.0 DAMSITE RECLAMATION PROGRAM

Following construction, the dam and associated disturbances will be reclaimed. The primary objectives of the reclamation program will be to:

1. stabilize the surfaces from the forces of wind and water erosion; and
2. to reestablish vegetation compatible with adjacent native plant communities.

The sites which are to be reclaimed, the desirable plant communities to establish on these surfaces and the recommended reclamation approach are described below.

The focus of the reclamation planning is on the dam site and adjacent areas as reclamation of the draw down zone in the reservoir will be difficult and highly dependent upon the stability of the new shorelines.

6.1 SITES TO BE RECLAIMED

Three types of sites will require reclamation. They are:

- the downstream dam slope and the abutment slopes;
- borrow pits not located within the reservoir; and
- preparation and laydown areas.

A detailed project description is not available at this time. However, in discussion with the project coordinator, the following site characteristics were established.

The dam is assumed to have a maximum slope of 2:1 (26°) on the downstream face. The downstream face, southfacing, will be revegetated while the entire upstream face will be armoured with rip-rap and will not be revegetated. A certain amount of disturbance will be created on the steep (approximately 30-35°) east and the west facing slopes into which the dam will be abutted. Following construction the slopes will be graded to blend in with the surroundings.

The majority of the earth materials required to construct the dam will likely be obtained from large impervious borrow sites near the dam abutments much of which may be above water level. Sand and gravel will, as far as possible, be taken from the reservoir. Rip-rap will be quarried off site. Excavations above the water level will be reclaimed following abandonment or final use.

Preparation and laydown areas are likely to be located on the level uplands on either side of the dam site. These sites will experience variable disturbance. A high degree of activity is expected in concrete mixing areas, parking lots, office areas, and fuel storage areas. Disturbance should be minor in the equipment storage and laydown area.

6.2 RECOMMENDED RECLAMATION APPROACH

For the purpose of preliminary planning the disturbed surfaces requiring reclamation have been grouped generically by soil texture, slope and aspect into three site types as follows:

Site Type	Soil Texture	Slope	Aspect
1	Coarse	Moderate to steep	All
	Medium to fine	Moderate to steep	S, E & W
2	Medium to fine	Moderate to steep	N
3	All	Level to gentle	All

Definitions:
Coarse textured soil - sandy loam to sand (greater than 60% sand and less than 10% clay)
Medium to fine textured soil - sandy loam to heavy clay (less than 60% sand and greater than 10% clay)
Gentle slopes - 6-9%
Moderate to steep slopes - 10-15% to 71-100%

The recommended approach in the reclamation of disturbed surfaces is to establish species that are adapted to these sites and compatible with the adjacent natural plant communities. Species have been selected from "target communities"; i.e., natural plant communities in the area which currently occupy sites with similar characteristics (soil texture, slope and aspect) to those which require reclamation. We suggest that two target communities be established:

1. Community Type 1A - the western wheat grass - June grass complex, on type 1 and 3 sites; and
2. Community Type 1B - the rough fescue - Parry oat grass complex, with shrubs from the Saskatoon - choke cherry shrub community (community type 2A) on type 2 sites.

The grass, shrub and herb components of these two target communities are described in Tables 4 and 5, respectively.

TABLE 4

WESTERN WHEAT GRASS - JUNE GRASS TARGET COMMUNITY

	Common Name	Botanical Name
Grasses:	Western wheat grass	Agropyron smithii
	June grass	Koeleria macrantha
	Bluebunch wheat grass	Agropyron spicatum
	Green needle grass	Stipa viridula
	Needle and thread	Stipa comata
Shrubs:	Buckbrush	Symphoricarpus occidentalis
	Ground juniper	Juniperus communis
	Prairie rose	Rosa arkansana
	Thorny buffaloberry	Sheperdia argentea
	Skunk-bush	Rhus trilobata
	Silverberry	Elaeagnus commutata
Herbs:	Bluebell	Campanula rotuntifolia
	Broomweed	Gutierrezia sarothrae
	Gaillardia	Gallardia aristata
	Golden aster	Heterotheca villosa
	Golden bean	Thermopsis rhombifolia
	Gumweed	Grindelia squarrosa
	Missouri milk vetch	Astragalus missouriensis
	Pasture sage wort	Artimesia frigida
	Prairie cone-flower	Ratibida columnifera
	Purple prairie clover	Petalostemon purpureum
	Pussy toes	Antennaria rosea
	Showy locoweed	Oxytropis splendens
	Wild blue flax	Linum lewisii

TABLE 5

ROUGH FESCUE - PARRY OAT GRASS TARGET COMMUNITY

	Common Name	Botanical Name
Grasses:	Rough fescue	Fescue scabrella
	Parry oat grass	Danthonia parryi
Shrubs:	Buckbrush	Symphoricarpos occidentalis
	Choke cherry	Prunus virginiana
	Shrubby cinquefoil	Potentilla fruticosa
	Saskatoon	Amelanchier alnifolia
Herbs:	False soloman's - seal	Smilicina racemosa
	Kidney - leafed violet	Viola renifolia
	Northern bedstraw	Galium boreale
	Old man's whiskers	Geum trifolium
	Prairie crocus	Anemone patens
	Sticky purple geranium	Geranium viscosissimum
	Sweet - flowered androsace	Androsace chamejasme
	Veiny meadow rue	Thalictrum venulosum
	Common yarrow	Achillea millefolium

The target communities contain the dominant grass and shrub components of corresponding native plant communities in the area, summarized in Appendix A. Due to the transitory nature of some of the herbs and the presence of grazing and drought, the herbaceous species described in this field survey, conducted in July, are not entirely representative of herbs present throughout the growing season. Therefore the list of herbaceous species was expanded to include native herbs commonly found throughout the season in the corresponding native communities.

6.3 SOIL SALAVAGE AND STORAGE

Topsoil contains plant propagules - buried seeds, roots and stolons, and microganisms which will assist in establishing native vegetation.

To assess the potential for plant establishment, five topsoil samples were collected from several western wheat grass - June grass stands near the damsite and transported to a growth facility. After two months in cold storage the topsoil was placed under a 16 hr/day light regime and maintained in a moistened state. In three months the following weeds and native herbs had emerged: dandelion (Taraxacum officinale), stinkweed (Thlaspi arvense), pasture sage (Artemesia frigida), and several different seedlings of the composite family too immature to identify. In addition, root stock regrowth from western wheat grass, June grass, golden bean and pasture sage occurred. The absence of grass seedling germination may have been the result of the lack of seed (overgrazing and drought) and/or the difficulty in breaking seed dormancy. While the salvaged topsoil will provide some plant propogules such as seeds and root stocks, the source is unreliable depending on weather grazing pressure, as well as handling and storage conditions, and it is recommended that grass seed be applied as indicated in Section 6.5.

Salvage of topsoil for replacement during reclamation is recommended in excavation areas and where the surface may be contaminated; e.g., fuel storage or concrete mixing areas. Stripping of topsoil on steeply sloping terrain, i.e., on the dam abutment slopes, is not considered feasible.

On surfaces where topsoil stripping is considered feasible, it is recommended that the upper 20 cm of soil be removed and stored adjacent to the site, prior to site development. The topsoil pile should have slopes of 3:1 or less, to minimize erosion during storage. If the soil is to remain in storage for longer than one month, seeding with an annual such as Prolific spring rye at 20 kg/ha and fertilizing with 11-48-0 at 100 kg/ha is recommended.

6.4 SITE PREPARATION AND TOPSOIL REPLACEMENT

Various activities may be required to prepare sites to receive topsoil. It is recommended that gravel pads and temporary concrete structures be removed, berms constructed around fuel storage areas be levelled, contaminated soil removed and disposed of in an appropriate landfill and gently sloping areas contoured to incorporate the drainage into the existing natural drainage of the area. Resloping of excavation pit walls to gradients of 3:1 or less is also recommended to increase the potential for successful reclamation. Borrow pit floors may be shaped to serve as a watering pond for livestock or wildlife. Finally, sites to receive topsoil should be graded to create a smooth surface for the uniform spreading of topsoil. Growing conditions on areas subject to heavy traffic during construction would be improved by deep ripping to relieve compaction, following topsoil replacement.

Salvaged soil may not be available for the reclamation of steeply sloping areas such as the dam and abutment slopes. In such situations, we recommend that topsoil be obtained from areas within the reservoir currently occupied by the target communities which are to be developed. For example, topsoil for type 1 and 3 sites could be obtained from areas occupied by the western wheat grass - June grass grassland (community type 1A) located within 2 km of the dam site. Areas selected should be relatively level and smooth for ease of equipment operations.

Topsoil obtained from these communities will contain seed and roots of the desired plants. Viability of these propagules should be high, since there will be no interim storage during which losses in viability could occur. Topsoil obtained from communities other than those being targetted will contain seed and other plant propogules which may interfere with the establishment of the desired plant community. A 20 cm maximum depth of stripping and replacement is recommended. Stripping of greater depths will result in the burial of a large amount of seed and root stocks beyond the depth where germination or establishment is considered feasible.

A rooting zone of 80 cm is desirable over the dam surface, requiring a 60 cm depth of suitable subsoil material. Granular material with 50% soil fines (material less than 2 mm) is the recommended minimum acceptable material for subsoil. Alluvium (silt and fine sand) deposited in the river flood plain would be best suited for subsoiling areas to be reclaimed.

6.5 PLANT COMMUNITY ESTABLISHMENT

Methods recommended for the establishment of the desired plant species are similar for the three site types. The replaced topsoil will provide improved growing conditions for establishing plants and will serve as a

source of plant propagules. However, the success of the establishment of these propagules contained within the topsoil cannot be predicted and will be dependent to a large extent on the growing conditions at the time and the procedures of handling the topsoil during salvage and replacement. Viability of the plant propagules should be high in salvaged topsoil placed directly on the reclamation site, however viability of plant propogules contained within stored topsoil may be reduced due to storage. To ensure that the desired plant species are established as rapidly as possible, we recommend the seeding and planting of the appropriate species following replacement of topsoil.

6.5.1 Grass Cover

The two suggested target communities require the establishment of two different grass seed mixtures. A mixture of rough fescue and oat grass is recommended for type 2 sites while a grass mixture containing western wheat grass, bluebunch wheat grass, needle and thread, green needle grass, and June grass is recommended for type 1 and 3 sites.

6.5.1.1 Sources of Native Grass Seed

Locally obtained seed is recommended to ensure that the grass is adapted to the local conditions. Due to the over grazing and the overall poor condition of the range in the area, seed set of the native grasses was poor in 1985 and will likely continue to be poor. In order to ensure a seed supply, we recommend that suitable areas containing the desired species be protected from grazing for a minimum of one and desirably two years prior to collection. Spring application of 75 kg/ha nitrogen and 30 kg/ha phosphate (P_2O) is recommended to stimulate plant growth and seed production (Johnston et al. 1975).

Sources of grass seed for the western wheat grass - June grass community are common in the reservoir while only two small stands of fescue grassland have been mapped within the reservoir. Steps should be taken immediately to identify suitable areas which can be taken out of production, i.e., grazing by livestock, for the purpose of producing seed for the revegetation program. Suitable sites should contain an abundance of the desired grass species and should be trafficable by farm machinery to enable harvesting with a conventional combine or forage harvestor.

All grass species of the western wheat grass - June grass community are commonly found within the reservoir (community type 1A) with the exception of bluebunch wheat grass. A stand of bluebunch wheat grass is located on the east side of the river immediately down stream of the dam site. Site conditions dictate that seed be collected by hand. Fencing would not be required as the area has apparently not been heavily grazed, due to the steep slope.

In the event that seed production is poor in the years prior to the dam construction, the seed collected could be increased by a seed grower. As a last alternative, seed may be purchased from commercial seed growers. While native strains of the desired native grass species may be available, the seed may not be adapted to local conditions. Should it be apparent that commercial native seed sources will be required, it is recommended that seeding trials be initiated as soon as possible. These trials should be established in cultivated soil in the Pincher Creek area and should be run for a minimum of two years to ensure that the plants are adapted to the area and viable seed is produced.

6.5.1.2 Harvesting Native Grass Seed

In areas trafficable with farm machinery, harvesting of seed with a conventional combine is recommended. If the sites are not accessible by machine, harvest will have to be conducted by hand. Due to the high cost of manual labour we would recommend that sites be selected to accommodate farm machinery, where possible. At the time of the last seed harvest, during the year in which the dam is to be revegetated, we would recommend that all the top growth be harvested (with a forage harvestor) and placed on the seeded areas as a mulch. Priority should be given to the use of this material on steep slopes. In addition to providing seed, the material would serve to protect the surface from wind and water erosion.

6.5 1.3 Storage of Grass Seed

The grass seed should be stored under conditions similar to that adopted for cereal grains. The seed should be dry (14% moisture content or less) at the time of storage and maintained at this moisture content during storage. Seed germination tests should be conducted to determine viability.

6.5.1.4 Application of Grass Seed and Mulch

The proportion of each species in the grass mixtures will be difficult to control when using locally harvested seed. However, the suggested composition of the grass mixtures are:

1. Western wheat grass - June grass target community

	% by Weight
Western wheat grass	40
June grass	10
Bluebunch wheat grass	15
Green needle grass	20
Needle and thread	15
	100

2. Rough fescue - Parry oat grass target community

	% by Weight
Rough fescue	75
Parry oat grass	25
	100

Reclamation sites should receive an application rate of 20 to 25 kg/ha (for broadcast application) of pure live seed. On the dam and abutment slopes this should be increased to 40 kg/ha pure live seed. Due to the variable amount of chaff and debris expected to be mixed with the seed, the application rate should be adjusted in order to achieve the desired application rate. Spring seeding is recommended, although seeding as late as mid-July may be feasible if supplementary water is available following seeding.

A range seed drill is the most desirable method of seeding. Seeding should be done along the contour in order to provide some protection from water erosion by establishing rows of plants oriented at right angles to the flow of surface water. (Broadcast application rates should be reduced by one-half when using the range drill.) However, a high amount of foreign debris (chaff, etc.), especially in locally collected seed, and steep slopes may limit the use of the range seed drill. Broadcast application is recommended on slopes not negotiable by machinery or when using seed with a high proportion of foreign debris.

The mode of broadcast application employed will depend on the amount of debris in the seed. Seed containing minor amounts of foreign debris could be applied to slopes with hand powered cyclone seeders. Seed which contains large amounts of foreign debris may be best applied directly by hand broadcast without the assistance of a cyclone applicator. On level areas such as exist in the preparation and laydown areas, truck mounted cyclone seeders may be used to apply seed-chaff mixtures. Application of mulch to the site with a straw blower is recommended.

6.5.2 Cover Crop Establishment

The primary objective of the revegetation program is to establish a plant cover capable of controlling surface wind and water erosion. Due to the characteristic slow establishment of native grass species it is recommended that a cover crop be seeded along with the native grass species. Spring rye, variety Prolific, applied at a rate of 20 kg/ha should provide a rapid plant cover adapted to the climate of the area. Should the establishment of the native grass cover be slow, spring rye could also be seeded in the second year to ensure that an adequate plant cover is present to protect the site from erosion.

6.5.3 Establishment of Herbaceous Plant Cover

6.5.3.1 Seed Collection and Storage

The topsoil will serve as a source of herbaceous propagules; however, to ensure that the desired diversity is achieved we also recommend seeding herbaceous species. As in the case of native grass seeds, we recommend that the seeds of herbaceous plants be obtained in the reservoir or

nearby. In order to maximize the diversity of herbaceous species collected in the target communities, collection during a minimum of two growing seasons is recommended.

Seeds should be hand collected as they ripen, just prior to dispersal. At a minimum, collections should be carried out in mid July and late August. The seed should be air dried at room temperature for two to three weeks, cleaned and stored dry at 3 to 6°C in the dark (Currah et al. 1982).

Suggested herbs for each target community are listed in Tables 3 and 4. Certain species should receive priority due to their abilities in erosion control or fixing nitrogen, while other species will be desireable because of their colourful, showy blossoms. Desireable herbs with extensive fibrous or tap root systems include broomweed, dwarf pussy toes, northern bedstraw, yarrow, tufted white prairie aster, and pasture sagewort. Leguminous species with nitrogen-fixing abilities include golden bean, showy locoweed and the Missouri milk vetch.

Commercial increase of locally collected seed should be considered to increase the seed of desirable herbs in the event that seed harvest is poor. The purchase of seeds from commercial seed suppliers is not recommended as the geographic origin is generally not known.

Published information regarding seed production abilities and germination potential is generally scarce for prairie herbs. D. Smreciu and colleagues (Smreciu 1985; Currah, Smreciu and Van Dyk 1982; Smreciu and Currah 1981) have however, done major work on herbs in Alberta grasslands. The Plant Propogation Section at the Vegreville Research Centre has also carried out considerable work developing methods of cleaning seed and procedures to enhance germination of prairie herbs

(Hermesh, pers. comm.). We suggest that these sources be contacted to obtain information pertinent to the herb collection program which will ultimately be implemented.

6.5.3.2 Seeding Native Herbs

We recommend that the desired mixture of herb seed be applied to the site in spring with the native grass seed to minimize competition from grasses. Herbs in the rough fescue community would do best seeded near shrub beds where site conditions are more mesic and protected from winds.

If certain herbs are desired within "critical" areas for aesthetic reasons, planting as rooted plugs is recommended. The Vegreville Research station have had success in out-planting herbs reared in Hilson containers (Hermesh, pers. comm.).

6.5.4 Shrub Establishment

Desired shrubs of the target plant communities are listed in Tables 3 and 4. Production from seed is recommended for all shrubs included in the target communities. As in the case of the grasses and herbs, seeds should be obtained from collections within the reservoir or nearby. Stands in which these shrub species are common can be identified in Appendix A and located on the accompanying map.

Seed should be collected in late August and early September. Special treatment to break dormancy is not required for any of the recommended species (Alberta Agriculture 1980, H. Kuperus pers. comm.). If seeded in fall, stratification is also not required. However, stratification would be necessary for all species if seeded in spring or summer.

Commercial nurseries can provide specific recommendations in this regard.

We suggest shrubs be reared in containers with a minimum soil volume of 75 cc, e.g., Hilson-fives, and outplanted in spring prior to the onset of active growth, i.e., the spring flush. The size and age at which the stock is suitable for planting will vary depending upon the ecological capabilities of the species and the site on which it is to be planted. Sites with coarse textured soils or southern exposures should receive larger stock. To compensate for seedling mortality, planting density should be 150% of the desired density.

Although shrubs could be planted on all reclamation sites, planting shrubs on steep slopes, e.g., the abutment slopes, is considered a priority to assist the grasses in stabilizing these surfaces. Selection of shrubs with soil erosion controlling capabilities and which are compatible with the adjacent natural plant cover would be desirable.

Planting density is considered important on the steep abutment slopes where the presence of shrub roots may be critical to maintaining soil stability. A spacing of 1 m X 2 m (surviving shrubs) is suggested. The placement of shrubs on the dam slopes is not considered critical to slope stabilization, and therefore aesthetic considerations could take priority.

6.6 FERTILIZATION

We recommend that a granular fertilizer be applied to the reclamation site during seeding. The formulation and rate of application should be determined following analysis of the topsoil and should be adequate to support a vigorous cover crop and the establishing native grasses and herbs.

6.7 SPECIAL MEASURES FOR RECLAMATION

Certain areas may require special measures to ensure the successful reclamation of the site.

6.7.1 Erosion Control Netting

To ensure that the topsoil and seed remains in place while the plant cover is establishing we recommend that slopes steeper than 26°, i.e., the dam abutment slopes, be covered with erosion control netting. Products such as Ludlow Soil Saver, or Curlex blanket would be suitable. In addition to providing erosion protection, these materials also serve as an effective mulch, conserving soil moisture.

Grassland mulch placed on the dam slopes will require a light weight netting to hold it in place. A Conwed erosion control netting, made of black polypropylene extruded plastic with a rectangular mesh opening 1.5 X 2 cm and a nominal weight of 1.18 kg per 93 m^2 (2.6 lb per 1000 ft^2) would be suitable.

6.7.2 Supplementary Watering

High winds, common in the area, and southern exposures may make revegetation difficult if timely rains are not received following seeding. Watering to supplement rainfall should be considered on critical areas, such as the dam and abutment slopes, to assist in the germination and establishment of seeded species. Supplementary watering could be discontinued after the native grasses achieve a height of 7 to 8 cm.

7.0 ASSESSMENT OF POTENTIAL IMPACTS OF THE OLDMAN RIVER DAM ON DOWNSTREAM VEGETATION

7.1 SCOPE AND METHODS

The purpose of this section is to access the effects of the alteration of flooding regime on vegetation communities downstream of the dam to the LNID headworks, particularly cottonwood communities and floodplain wetlands. Due to the general lack of follow-up studies on the downstream effects of dams in southern Alberta, a brief review of the literature was made to determine general short- and long-term impacts of dams. The second step was to establish permanently marked transects downstream of the dam where data on factors which may be influenced by the dam, including channel migration, sedimentation rate, cottonwood seedling establishment and vegetation growth, can be monitored at periodic intervals following dam construction. The data from these transects, in conjunction with more detailed information on the effect of the dam on the river flow regime, can then be used to quantitatively assess the downstream impacts on vegetation.

The sample transects were originally proposed on some three to five actively aggrading point bars downstream to the LNID headworks. Since access to the Peigan Indian Reserve was denied, three sample transects were established between the dam site and the Highway 785 bridge over the Oldman River. Because this portion of the river valley lacked floodplain wetlands, the assessment focuses primarily on cottonwood communities and associated cottonwood and willow regeneration on gravel bars.

7.1.1 Field Methods

The monitoring transects were located on the same floodplain point bars on which concurrent fisheries studies were being conducted. The transect was placed on actively aggrading point bars that had a well defined sequence of vegetation types from upland to water's edge reflecting several stages of floodplain development. Actively aggrading floodplains are most useful as monitoring sites, as it is on these surfaces that changes, if present, in the river flow regime will first be evident in the vegetation. The cottonwood communities dominate the floodplain portion of the river valley downstream of the dam and the transect locations were chosen to be representative or typical of this vegetation. Access was by vehicle to all sites.

The transects were permanently marked by nailing an orange florescent plaque 5 X 5 cm in size to a selected cottonwood. The sites were pin-hole marked on air photos and a detailed drawing was made of each location. Where possible, the transect was tied-in to other survey pins in the area. Photographs (35 mm) were taken of each transect to aid in locating the position of the marked tree.

The topography of the point bar above the water level along the transect was measured using standard differential level surveying methods. Soil conditions and sedimentation profiles were determined by digging test pits beside cottonwood seedlings and relating rooting depth to stem age and height above the water level.

Since homogeneous vegetation types occur in bands or arcs parallel to the adjacent river channel, rectangular vegetation plots (2 m X 10 m) were established at right angles to the transect line. Data on species cover by strata was collected, and tree measurements of age, diameter

and height were taken where tree occurred. Tree age was determined by cutting discs from seedlings and by coring mature trees. In addition, data on the density of woody stems in each plot was collected.

7.1.2 Sedimentation Rates

Present day sedimentation rates were calculated based on the elevation above water level which the cottonwood seedlings have become established, compared to the elevation and age of mature cottonwoods on the floodplain. The major assumption is that once the seedling has become established, it will grow and mature with subsequent sedimentation events until the floodplain builds up to the present level occupied by mature cottonwoods. Thus if a 10 year old seedling is established at approximately 100 cm above the water level, and a mature cottonwood 50 years old is found at 220 cm above water level or 120 cm higher; then the assumption is that 120 cm (100 to 220 cm) of sediment has build up over a 40 year period (10 to 50 years) or a rate of 3 cm/yr.

This conceptual model was confirmed by partially excavating a root system of a mature cottonwood on a cut bank along transect 107. The cottonwood, 83 years old, had rooted initially on the underlying gravel layer and had 210 cm of sediment from the root origin to the present ground surface (Photo 5). By allowing about 10 years for seedling establishment with little or no sediment accumulation (Bradley 1982), the 210 cm of sediment had built up over 73 years, which is a rate of 2.9 cm/yr.

The major limitation to this model is determining the exact age of the cottonwood. The annual rings are indistinct with the result that some underestimation is possible. The second problem is that the older portion of the root or buried stem often begins to rot which tends to

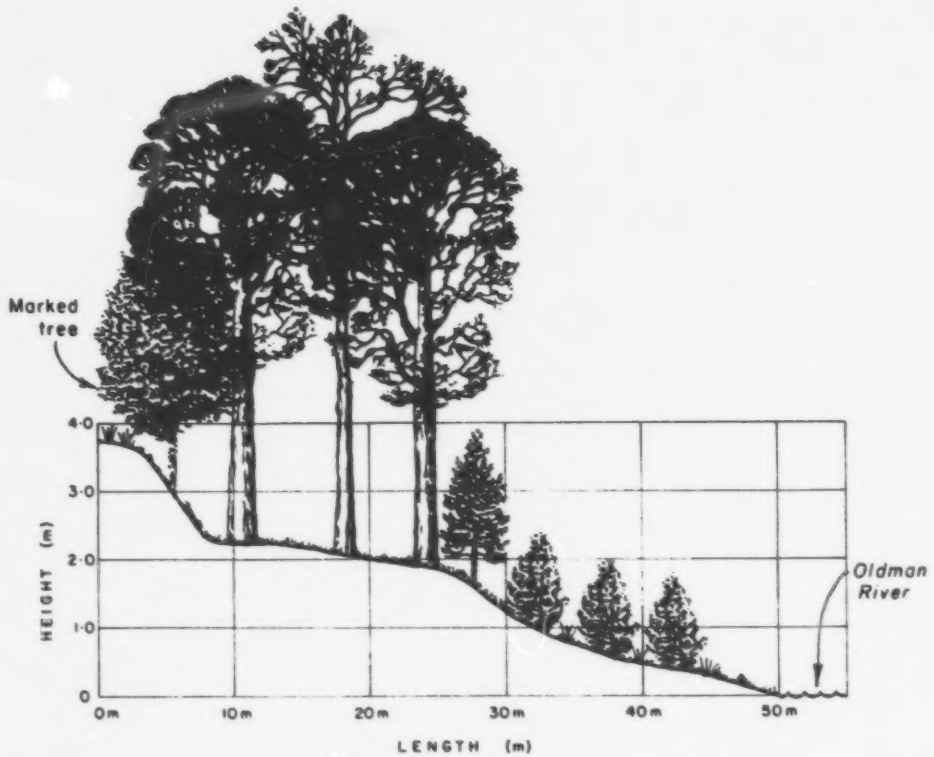
obscure the growth rings. The third difficulty involves the estimation of the number of years that the seedling survived on the gravel bar before substantial sediment accumulation occurred, thus the ten year estimate. In the absence of any other data, this method is believed to provide a rough but reasonably accurate estimation of sedimentation rates.

7.2 DOWNSTREAM TRANSECTS

The following is a brief description of the major characteristics of each transect. The data is presented by transect to aid in further comparisons of potential changes which may have occurred on that transect. The location of the transects is shown on Map 1 and detailed drawings and access notes are presented in Appendix C. Tree and species composition data are given in Appendix D. A file of photographs of each of the three transects is included under a separate cover.

7.2.1 Transect 106

Transect 106 is located on the north side of the Oldman River approximately 3.5 km downstream of the dam site. The narrow floodplain is near a small rodeo ground next to a barn and corral (Appendix C, Figure 1). The profile along the transect is gently sloping in a young cottonwood stand, then it drops steeply through a zone of cottonwood regeneration and willows to the water's edge (Figure 4). The rate of sedimentation is approximately 4.0 cm/yr reflecting the young age of the point bar (Table 6).



Vegetation Type	Grass	Cottonwood	Cottonwood regeneration		Gravel	Water
Density of woody stems/m²		0·5	1·6	2		

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PROFILE OF TRANSECT 106

Figure 4

TABLE 6

APPROXIMATE SEDIMENTATION RATES ON TRANSECTS 106, 107 AND 108

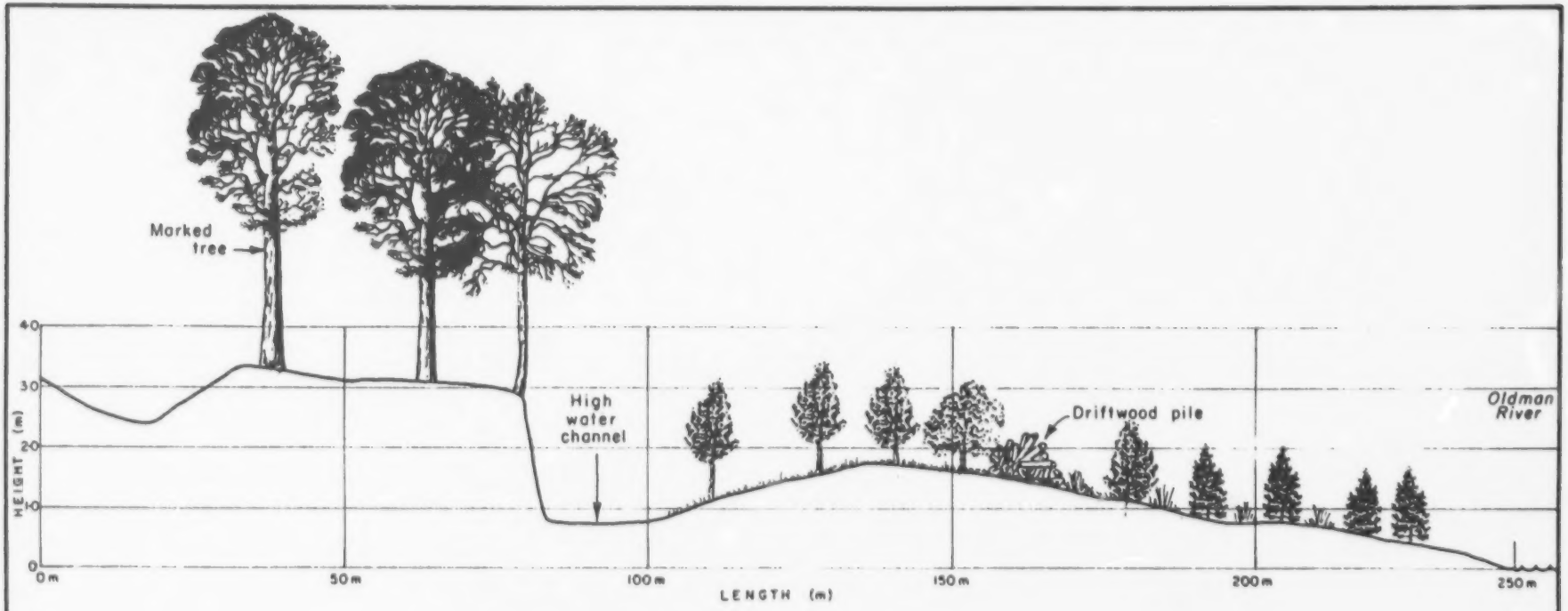
Transect	Cottonwood Age (yr)			Elevation (cm)			Sedimentation Rate cm/yr
	Seedling	Tree	Diff	Seedling	Tree	Diff	
106	11	34	23	116	207	91	4.0
107	10	83	73	68	278	210	2.9
108	6	60	54	93	319	226	4.2
	6	95+	89	93	204	111	1.3

7.2.2 Transect 107

Located 2 km downstream of the dam on the south side of the Oldman River is transect 107. The transect is on the large floodplain below the gravel pit area, west of the water reservoir, small barn and cottage (Appendix C, Figure 2). The transect begins on a level grass meadow next to a mature cottonwood stand, then the profile drops abruptly down a near vertical cutbank to a channel which only carries water during floods (Figure 5). The profile rises gently through a zone of cottonwood regeneration with a large pile of driftwood at the highest point, then gently drops along a zone of cottonwood regeneration and willow to the water's edge. The sedimentation rate of 2.9 cm/yr reflects the slowing down of sedimentation as the floodplain becomes higher (Table 6). As mentioned previously the sedimentation data is from a partially excavated root system of a mature cottonwood along the cutbank.

7.2.3 Transect 108

Transect 108 is located 5 km downstream of the dam on the north side of the Oldman River. The transect is west of the irrigation reservoir and pump station, and can be accessed via the trail parallel to the ditch from the river to the reservoir (Appendix C, Figure 3). The profile begins on a level ground surface under an old cottonwood stand (95 years) at the base of the sandstone cliff, which is soon intersected by a ditch which carries water to the irrigation reservoir (Figure 6). A second younger cottonwood stand (50 years) beginning at the trail has a very uneven ground surface owing to the mounds of silt and fine sand sediment 25 to 75 cm high which have built up on the lee sides of cottonwood trunks. The profile drops down a low cutbank, then gently



Vegetation Type

Western wheat grass-June grass	Cottonwood	Barren	Cottonwood regeneration			Gravel	Water
Density of woody stems/m^2	0·2		Cottonwood	2·8	2·0		
			Sandbar willow	2·0	8·0		

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PROFILE OF TRANSECT 107

Figure 5

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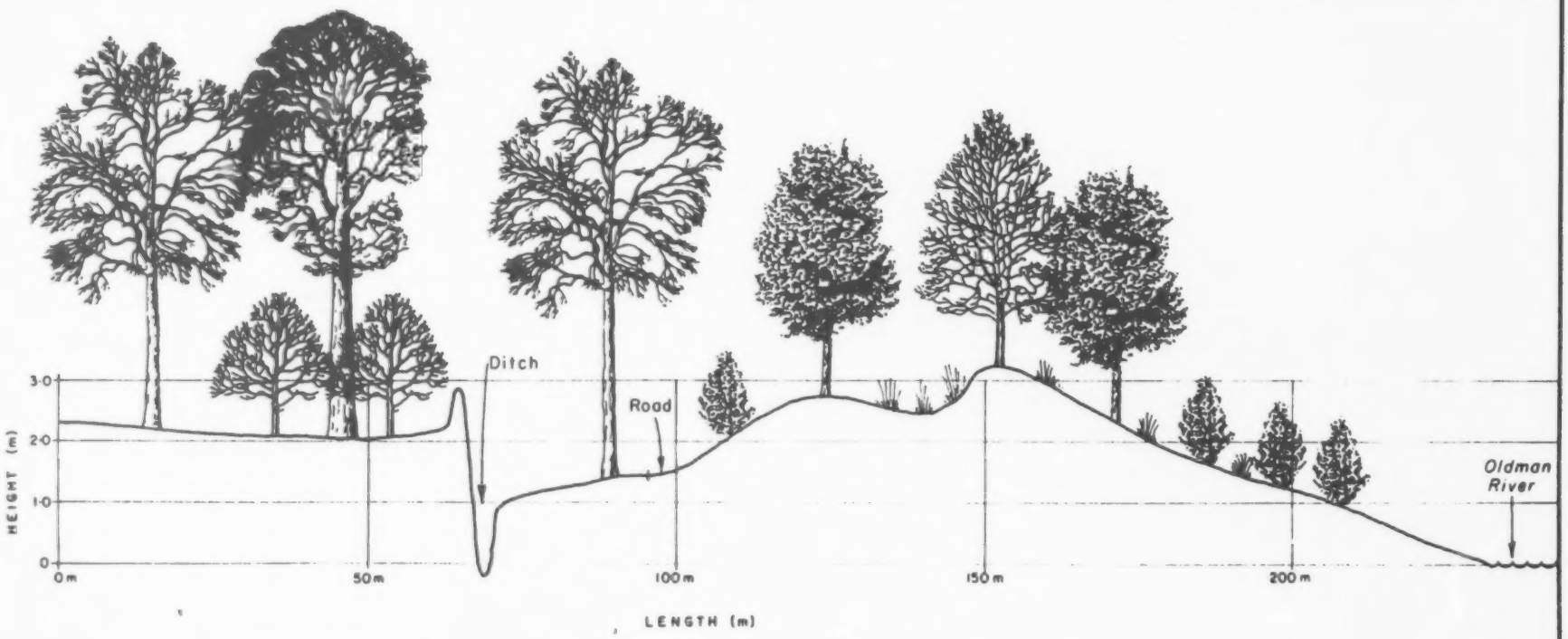

Vegetation Type	Cottonwood		Cottonwood regeneration	Gravel	water
Density of woody stems/m²	0·13	0·18	Cottonwood 11·3 Sandbar willow 0·6		

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PROFILE OF TRANSECT 108

Figure 6

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slopes down through a zone of cottonwood regeneration and willows to the water's edge. Sedimentation rates are higher in the younger cottonwood at 4.2 cm/yr compared to 1.3 cm/year under the old cottonwoods.

7.3 POTENTIAL IMPACTS

Downstream impacts of dams on vegetation are generally related to changes in the river flow regime due to regulation. The changes include alteration of flood frequency, sedimentation rates, channel morphology and lateral channel migration (Bradley 1982, Baxter and Glaude 1980). Subsequently, these changes will have effects on the downstream riparian vegetation in terms of tree establishment and shrub invasion.

In a study of the effects of a dam on the Milk River in Montana, Bradley (1982) documented several changes. The Fesno Dam completed in 1939, had little effect on the average monthly June through August flows downstream, but has reduced maximum instantaneous discharges by approximately 50%. The average channel width in a 15 km reach downstream has decreased by about 16.8 m, and the average rate of meander migration has been decreased significantly from 1.75 m/yr to 0.42 m/yr. The effect has been to cause a significant decrease in the amount of successful cottonwood establishment due to stagnation of point bar surfaces.

The downstream impacts of the Oldman River dam are difficult to predict until a detailed model of the river regime, including flood frequency, sedimentation and channel morphology, is completed. The preliminary analysis indicates that since the dam will act as a storage reservoir for the downstream LNID headworks and canal, the river regime may not be altered to the same extent as the Milk River described previously. The following flow scenario for the Oldman River has been provided (R. Middleton pers. comm.). The winter flow is likely to be slightly

higher than at present. The spring flood peaks are likely to be reduced, however substantial flood flows will still occur. As most sediment is expected to be trapped behind the dam, the downstream channel may experience some degradation and erosion rather than sedimentation.

While more information is needed to clearly assess long-term impacts the following changes may occur. With some reduction in flood peaks, sedimentation and possible channel erosion, cottonwood establishment is likely to be reduced on the gravel bars to a certain extent. Most of the higher gravel bars, currently covered by willow and cottonwood seedlings, are likely to develop a dense tall shrub and cottonwood cover, while the lower portions of the bars will likely remain as they are now, partially barren or with low cover of willow and cottonwood seedlings. This latter type will likely be restricted to a smaller, narrower portion of the floodplain, while the dense shrub and cottonwood stands will enlarge in area. The monitoring transects, when measured at periodic intervals following dam construction, will provide an assessment of downstream changes. This vegetation assessment, along with detailed information on the altered river flow regime, will then allow for the more accurate prediction of long-term impacts.

Due to the wide floodplain and abundance of cottonwoods, most of these changes are likely to occur along the Oldman River valley from the Highway 785 bridge to the LNID headworks through the Peigan Indian Reserve.

7.4 MIGITATION MEASURES

If initial monitoring and analysis of flow regimes indicate that point bars or other exposed surfaces suitable for cottonwood regeneration will be reduced, then mitigative measures to help maintain the cottonwood

stands along the Oldman River may be necessary. This replacement could take the form of periodic planting of trees and/or periodic water releases similar to normal high flood events to encourage natural regeneration.

Cottonwoods occur in a variety of age classes up to a maximum age of approximately 125 years. Periodic planting of cottonwood seedlings every 10 to 20 years along selected portions of the floodplain would likely be the best method to help maintain the species in a wide range of age classes. This periodic planting would essentially duplicate cottonwood establishment by natural means. The planted sites must be protected from livestock grazing for several years to prevent losses from trampling and browsing.

Cottonwoods seed beds could also be created by periodic water discharges from the dam at a level similar to natural flood events. However the socio-economic aspects of such measures would need to be carefully evaluated.

The value of the cottonwood stands along the river for wildlife and recreation could be increased with control or exclusion of livestock grazing in selected areas. These areas could include cottonwood stands, riparian shrubs, as well as shrub and tree stands along the valley banks.

8.0 RECOMMENDATIONS

8.1 RECLAMATION

1. Native plant communities suitable for the production of native grass seed, discussed in Section 6.4.1, should be selected and protected from grazing as soon as possible. To enhance growth and seed production these sites should receive an application of 11-55-0 at 100 kg/ha in spring of each year.

2. Should native grass seed production be poor, commercial native seed sources may be required. As soon as this is apparent, testing of commercially available native seed lots should be initiated. Small plots should be seeded in cultivated soil, and monitored for at least two years to ensure that the plants are adapted to the area and viable seed is produced.

3. Collection of seed from native herbs and shrubs desired in the targetted reclamation communities should be initiated so as to obtain seed during at least two successive years prior to final reclamation of the dam site.

4. The desired herbaceous component of the reclamation target communities should be finalized and optimum methods for establishment of these species developed. Consultations with A. Smreciu of the Alberta Devonian Botanic Gardens and R. Hermesh of Vegreville Research Station are recommended.

8.2 MONITORING

1. Once the Oldman River dam is constructed a program for monitoring the long-term effects of the project should be put in place utilizing the permanently marked transects as a baseline. Monitoring should include periodic study of sedimentation, seedling establishment and vegetation growth.

2. The monitoring program should be expanded to include an assessment of potential changes in river morphology including channel width and rate of meander migration. This study should be based on a comparison of the earliest air photos available for the Oldman River valley and air photos taken periodically after dam construction (every three to five years). The air photo study should be confirmed by ground control points.

3. Since most of the downstream changes to the cottonwood stands are likely to occur in the Peigan Indian Reserve, efforts should be made to obtain cooperation from the Band so that additional and more typical monitoring transects can be established on Reserve lands before dam operation.

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APPENDIX A

Tree Data and Percent Cover of Species in each Vegetation Community Type by Sample Site

APPENDIX A

TREE DATA AND PERCENT COVER OF SPECIES IN EACH OF THE VEGETATION COMMUNITY TYPES BY SAMPLE SITE

| | Vegetation Types | | |

APPENDIX B

List of Common and Botanical Names

APPENDIX B

LIST OF COMMON AND BOTANICAL NAMES

Common Name	Botanical Name
Trees	
aspen	*Populus tremuloides*
cottonwood	*Populus* spp.
Douglas fir	*Pseudotsuga menziesii*
limber pine	*Pinus flexilis*
Tall Shrubs	
choke cherry	*Prunus virginiana*
sandbar willow	*Salix exigua*
saskatoon	*Amelanchier alnifolia*
silverberry	*Elaeagnus commutata*
water birch	*Betula occidentalis*
western clematis	*Clematis ligusticifolia*
Low Shrubs	
buckbrush	*Symphoricarpos occidentalis*
common bearberry	*Arctostaphylos uva-ursi*
creeping juniper	*Juniperus horizontalis*
ground juniper	*Juniperus communis*
hawthorn	*Crataegus douglasii*
prairie rose	*Rosa arkansana*
prickly rose	*Rosa acicularis*
shrubby cinquefoil	*Potentilla fruticosa*
skunk-bush	*Rhus trilobata*
snowberry	*Symphoricarpos albus*
thorny buffalo-berry	*Shepherdia argentea*
wild gooseberry	*Ribes hirtellum*
Grasses	
awnless brome	*Bromus inermis*
bluebunch fescue	*Festuca idahoensis*
bluebunch wheat grass	*Agropyron spicatum*
bluegrasss	*Poa* spp.
green needle grass	*Stipa viridula*
Indian rice grass	*Oryzopsis hymenoides*
June grass	*Koeleria macrantha*
needle and thread	*Stipa comata*
northern wheat grass	*Agropyron dastystachyum* var. *riparium*

APPENDIX B - Continued

Common Name	Botanical Name
Grasses - Continued	
Parry oat grass	Danthonia parryi
rough fescue	Festuca scabrella
timothy	Phleum pratensis
western wheat grass	Agropyron smithii
Herbs	
alfalfa	Medicago sativa
beggar-ticks	Lappula occidentalis
blue-bur	Lappula squarrosa
broomweed	Gutierrezia sarothrae
Columbia puccoon	Lithospermum ruderale
common dandelion	Taraxacum officinale
cow parsnip	Heracleum lanatum
fairy-bells	Disporum trachycarpum
golden aster	Heterotheca villosa
golden bean	Thermopsis rhombifolia
hound's-tongue	Cynoglossum officinale
Indian hemp	Apocynum cannabinum
kidney-leaved violet	Viola renifolia
moss phlox	Phlox hoodii
northern bedstraw	Galium boreale
prairie crocus	Anemone patens
prairie sagewort	Artemesia frigida
prickly pear	Opuntia polyacantha
pussy-toes	Antennaria spp.
showy aster	Aster conspicuus
star-flowered Solomon's-seal	Smilacina stellata
sticky purple geranium	Geranium viscosissimum
stinkweed	Thlaspi arvense
sweet-flowered androsace	Androsace chamaejasme
sweet cicely	Osmorhiza chilensis
veiny meadow rue	Thalictrum venulosum
wild licorice	Glycyrrhiza lepidota
yellow umbrella plant	Eriogonum flavum
Moss	
feathermoss	Pleurozium schreberi

APPENDIX C

Location Diagrams and Access Descriptions
for Transects 106, 107 and 108

ACCESS

A) TRANSECT 106

Transect 106 is located on the north side of the Oldman River downstream of the proposed dam site in LSD 4, Sec 15, Tp 7, R 29, W4M. Access is via Highway 785 2 km north from the junction with Highway 3. Turn west on the first gravel access road north of the bridge over the Oldman River. Proceed west 2.5 km until road ends south of an abandoned farmstead, take trail south passing west of the rodeo ground to edge of cottonwood stand. The marked tree is a small young cottonwood approximately 100 m west of this point (Figure 1).

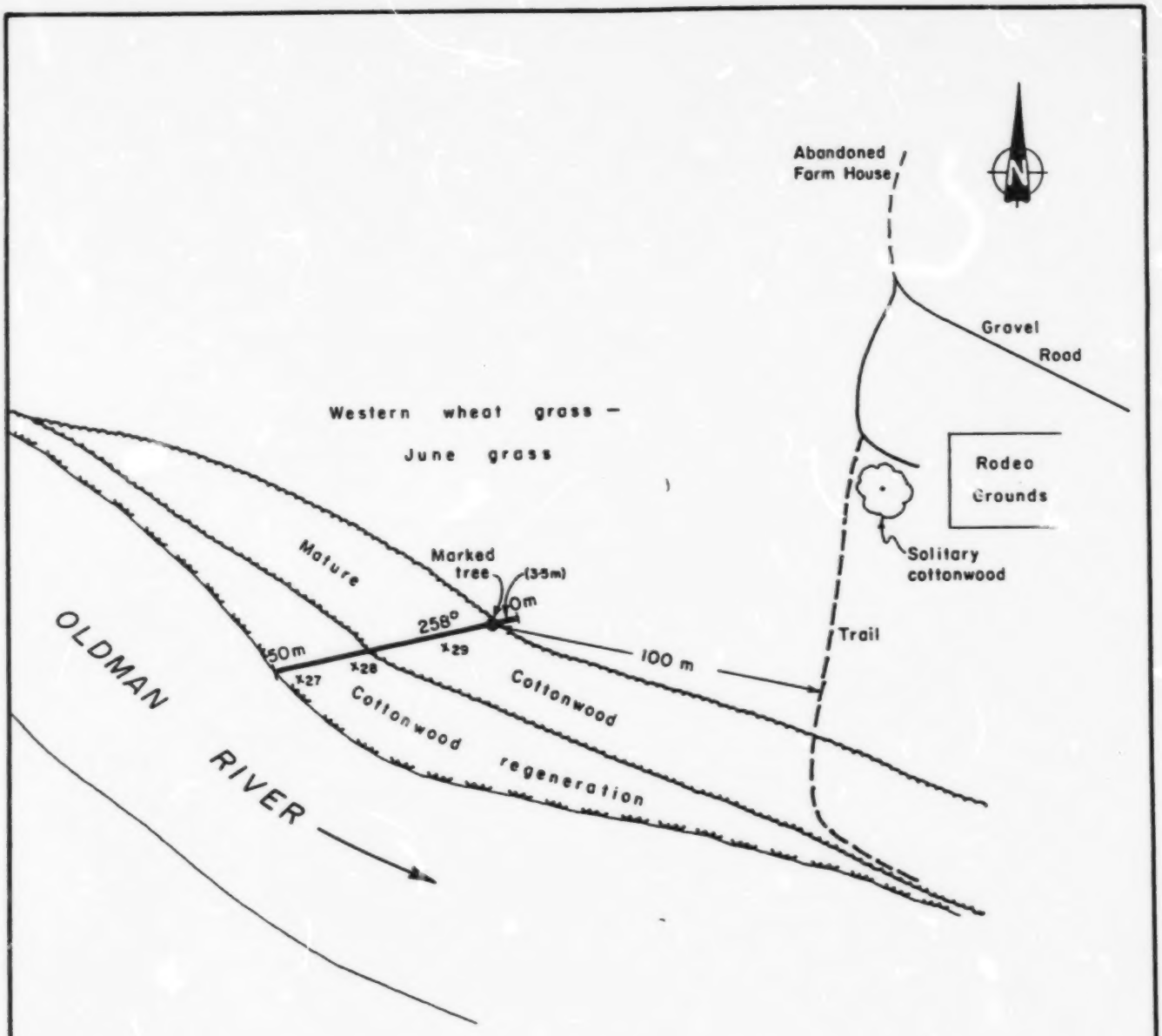
B) TRANSECT 107

Transect 107 is located on the south side of the Oldamn River downstream of the proposed dam site in LSD 6, Sec 16, Tp 7, R 29, W4M. Access is via a road to several gravel pits 3 km west of junction of Highway 3 and Highway 785. Turn north on gravel access road and travel for 2.5 km passing an abandoned and active gravel pit to the west of the road. Follow the trail down the the floodplain and proceed 1 km to the west end passing a reservoir, small barn and cottage. The marked tree is on the south edge of the cottonwood stand approximately 50 m north of the solitary cottonwood (Figure 2).

C) TRANSECT 108

Transect 108 is located on the north side of the Oldman River downstream of the proposed dam site in LSD 4, Sec 14, Tp 7, R 29, W4M. Access is via Highway 785 2 km north of junction with

Highway 3. Turn west on the first gravel access road north of the bridge over the Oldman River. Proceed west 0.8 km to the irrigation pipeline which crosses the road, then turn south along a trail parallel to the pipeline and continue to the pump station then east around the reservoir. After paralleling the irrigation water pipeline a short distance, turn west on the trail which crosses over the pipeline and proceed about 1 km until the trail ends at the gate to the ditch at the side of the river (Figure 3). The marked tree is a large mature cottonwood near the base of the sandstone cliff, beside a natural spring which has been modified to provide water for livestock.



NOTES

(a) X - Sample site

(b) Air photo - AS 1431 - LI - 294

(c) Legal location - L.S.D. 4, S. 15, T. 7, R. 29, W4M

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LOCATION OF TRANSECT 106

Figure 1

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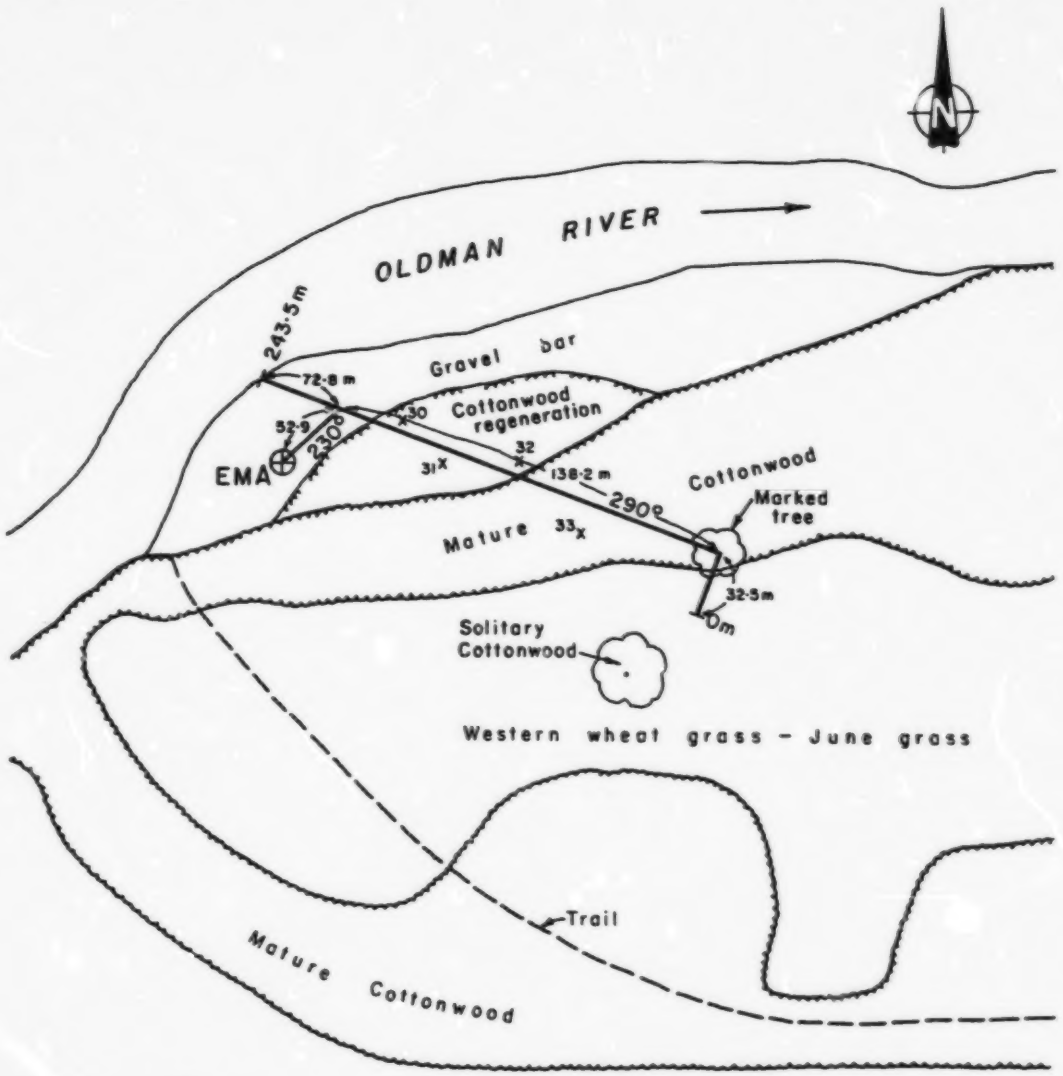

NOTES

(a) EMA - Reach 6, Transect 7, Right downstream, work pin

(b) X - Sample site location

(c) Air photo - AS 1431 - L1 - 294

(d) Legal location - LSD 6, S.16, T.7, R.29, W4M

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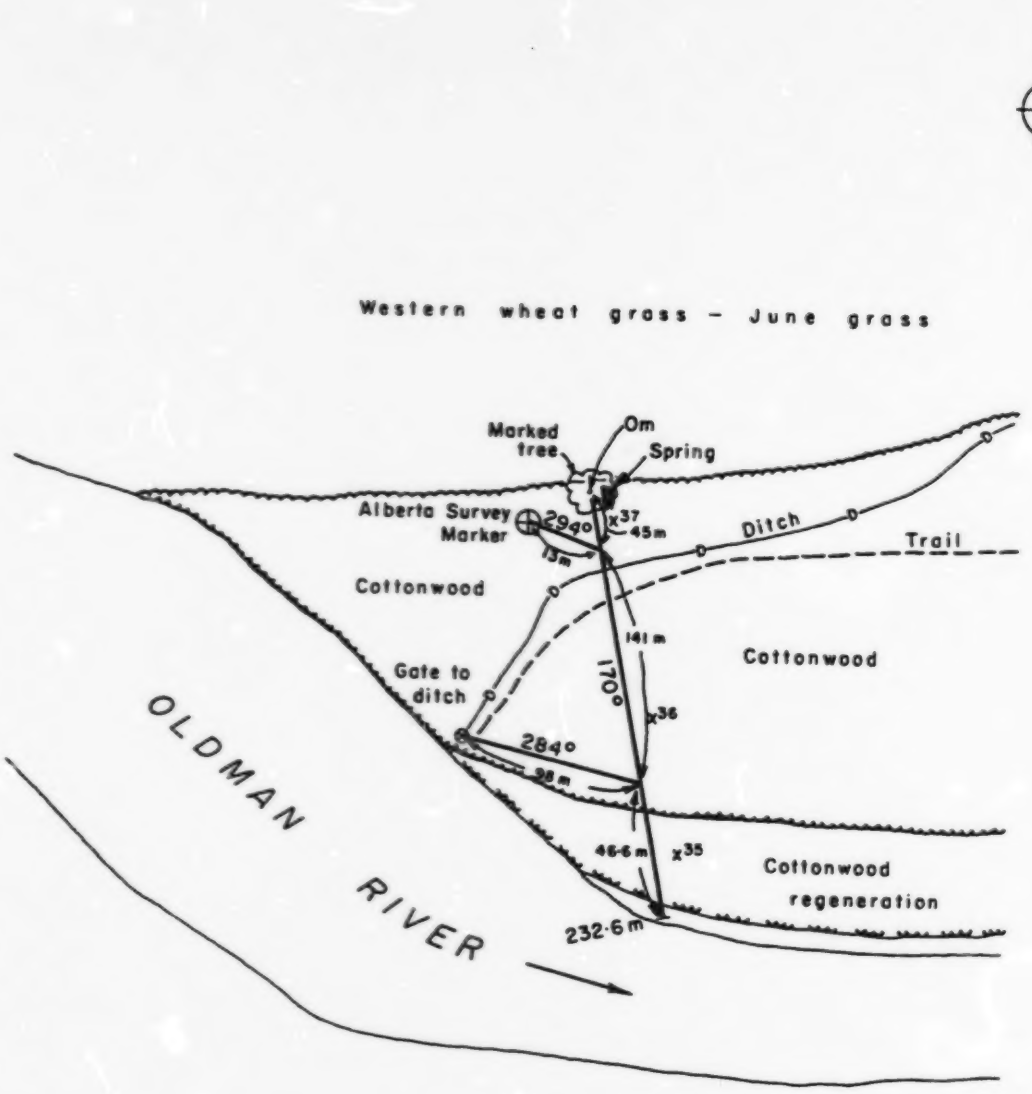
LOCATION OF TRANSECT 107

Figure 2

HT09 - 79/05



NOTES

(a) X – Sample site

(b) Air photo – AS 1431 – LI – 294

(c) Legal location – L.S.D. 4, S. 14, T. 7, R. 29, W4M

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LOCATION OF TRANSECT 108

Figure 3

HT09 - 79/05

APPENDIX D

Tree Data and Percent Cover of Species in Vegetation Community Types Found on Transects 106, 107 and 108

TREE DATA AND PERCENT COVER OF SPECIES
IN VEGETATION COMMUNITY TYPES FOUND ON TRANSECTS 106, 107 AND 108

	Transect 206			Transect 107 Stand No.						Transect 108		
	27	28	29	30			31	32	33	34	35	36	37
Vegetation Communities	WG	CR	C	W	WG	C	CR	WG	C	G	CR	C	C
TREE DATA													
Ht (m)	0.2	0.3	18.0	0.4	0.3		7.5		15.0		0.9	13.0	17.0
Dia (cm/dbh)	1.5	4.0	26.0	2.5	2.4		1.5		47.0		2.0	28.0	60.0
Age	3.0	6.0	34.0	6.0	3.0		10.0		70.0		6.0	49.0	78.0
Density (stems/m^2)													
Populus spp.			0.5		2.0		2.8		0.2		11.3	0.2	0.1
Salix spp.	2.0	1.6			8.0		2.0				0.6		
SPECIES													
Trees													
Populus spp.			40						40			45	40
Tall Shrubs													
Populus spp.		8										30	12
clematis ligusticifolia			3									2	2
Prunus virginiana			3										3
Amelanchier alnifolia													50
Elaeagnus commutata													20
Low Shrubs													
Populus spp.		25	2		3		30				65		
Salix exigua	3	2			35						5		
Clematis ligusticifolia			3						5		2	15	5
Symphoricarpos occidentalis									15			10	20
Elaeagnus commutata		3	5										3
Sheperdia argentea			3									2	
Rosa acicularis									2				3
Amelanchier alnifolia												2	3
Herbs													
Taraxacum officinale		2	3		2		3	2			2	2	
Thermopsis rhombifolia		2	15									2	
Mentha arvense					5			5			3		
Cirsium arvense							5	2					
Plantago major								2			3		
Chrysanthemum leucanthemum		2					2						
Glycyrrhiza lepidota								15					
Grasses													
Agrostis exarata	25	10			5		5	40			20	2	
Poa sp.			15		5		5	15					
Agropyron smithii			8		2		5	15					
Bromus inermis							5		10			30	10

Note: Vegetation Communities: WG - willow grass CR - cottonwood regeneration
C - cottonwood G - grass